Final
Operation, Maintenance
and Monitoring Plan

for the

Sand Springs Petrochemical Complex Site

Tulsa County, Sand Springs, Oklahoma

Prepared for:
Atlantic Richfield Company

July 2007

Stallion Environmental
Springfield, Missouri

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1. INTRODUCTION

The Operation, Maintenance and Monitoring (O&M) plan for the Sand Springs Petrochemical Complex describes a program of periodic inspections and maintenance activities for the site. This proposed O&M plan supercedes previously submitted draft versions of the Landfill Groundwater Monitoring Plan and the Consolidated Final Design Report Volume XII Post Closure Plan. The previous plans were prepared prior to landfill closure and do not adequately reflect work and reporting requirements for the site. The plan is in effect for a 30 year period following the 1995 closure of the landfill.

1.1. Purpose of the Operation, Maintenance and Monitoring Plan

The purpose of the plan is to provide a set of procedures that will monitor the performance of the landfill site and maintain integrity of the site during the 30 year maintenance period following closure of the on-site landfill.

This plan defines four major work components:

- Site and Landfill Inspections
- Site Maintenance Procedures
- Landfill Leachate Collection Procedures
- Landfill Groundwater Monitoring

1.2. Site History

The Sand Springs refinery was constructed in the early 1900's. It was the operating location of the Pierce Petroleum Refinery from the early 1900's to 1930, and the Sinclair Refining Company from 1930 to 1948. In 1948, the refinery was shut down and subsequently dismantled. Between 1948 and 1955, Sinclair sold most of the property to the Sand Springs Home. Subsequently, the Home sold and leased portions of the property to various industrial operators. In 1969, the former refinery operator, Sinclair, merged with the Atlantic Richfield Company.

The Sand Springs Petrochemical Complex was proposed for inclusion on the Superfund National Priorities List (NPL) in September 1983 and the site was officially added to the NPL in June 1986. In 1990, ARCO entered into a Consent Decree with the United States Environmental Protection Agency (USEPA) and the Oklahoma State Department of Health (now, Oklahoma Department of Environmental Quality) to remediate the site. A Superfund Remedial Action was implemented for the site and Atlantic Richfield completed the Remedial Action in 1995. The site was delisted from the NPL in 2000.

The remedial action involved excavation of petroleum sludge waste, stabilization/solidification of the waste, and placement of approximately 204,000 cubic yards of the stabilized material in an on-site landfill that met the requirements of a RCRA Subtitle C Landfill. A leachate collection and detection system, security fencing, and surrounding monitor wells were installed as part of the remediation system. Landfill closure activities are documented in the Construction Report.

In 2002, additional petroleum wastes were identified between the Arkansas River and the adjacent levee. In October 2004, Atlantic Richfield and EPA signed an AOC to conduct an emergency removal action. Wastes were excavated and properly disposed at the WMI Quarry Landfill in accordance with regulatory requirements of the Oklahoma Department of Environmental Quality. The project was completed in February 2006, and construction report was submitted to the EPA on April 25, 2006.

1.3. Site Location

The site is located on the north bank of the Arkansas River in Sand Springs, Tulsa County, Oklahoma. The location of the site is shown in Figure 1 and a map of the landfill is shown in Figure 2

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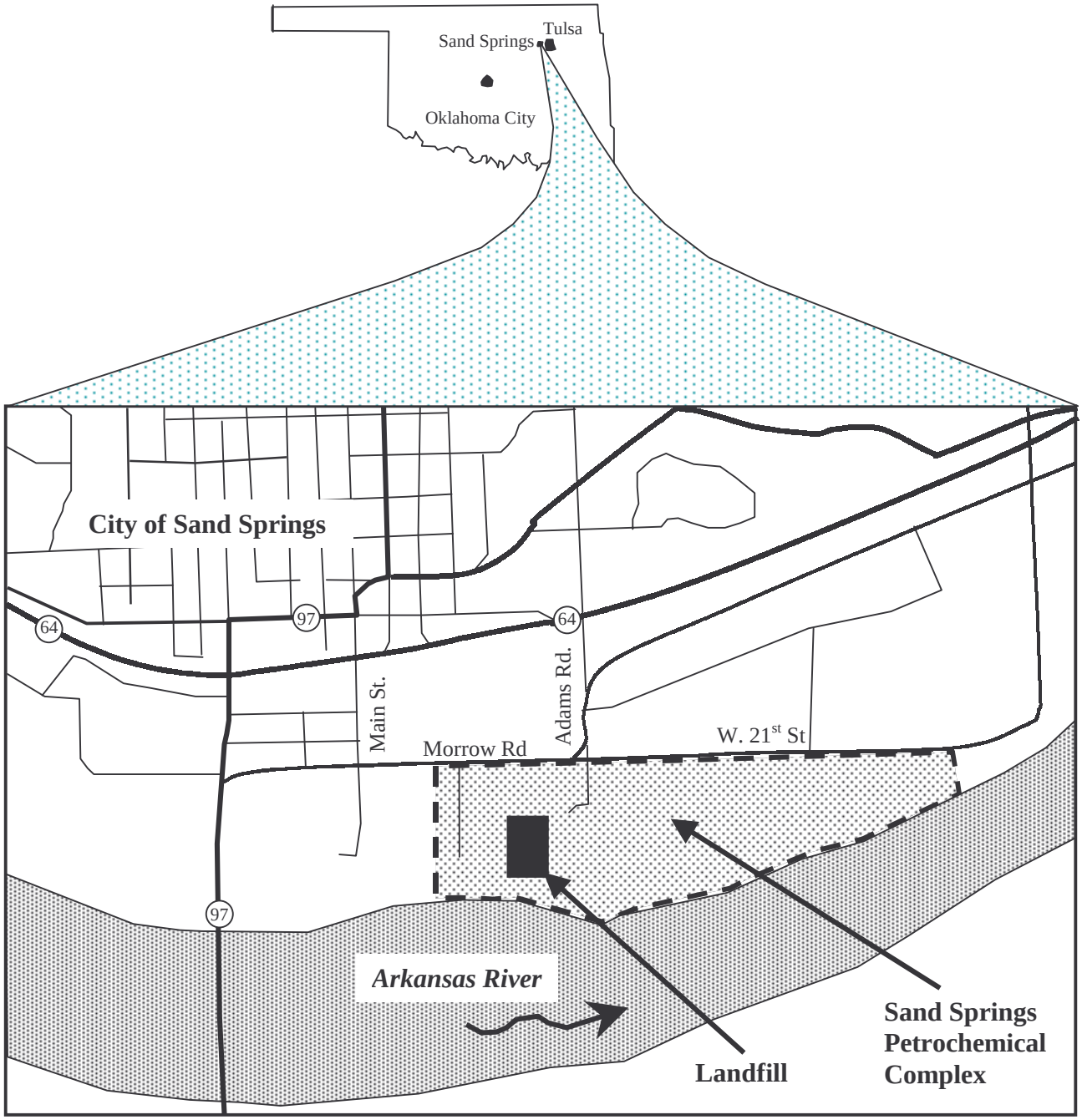


Figure 1 – Location of the Sand Springs Petrochemical Complex Site.

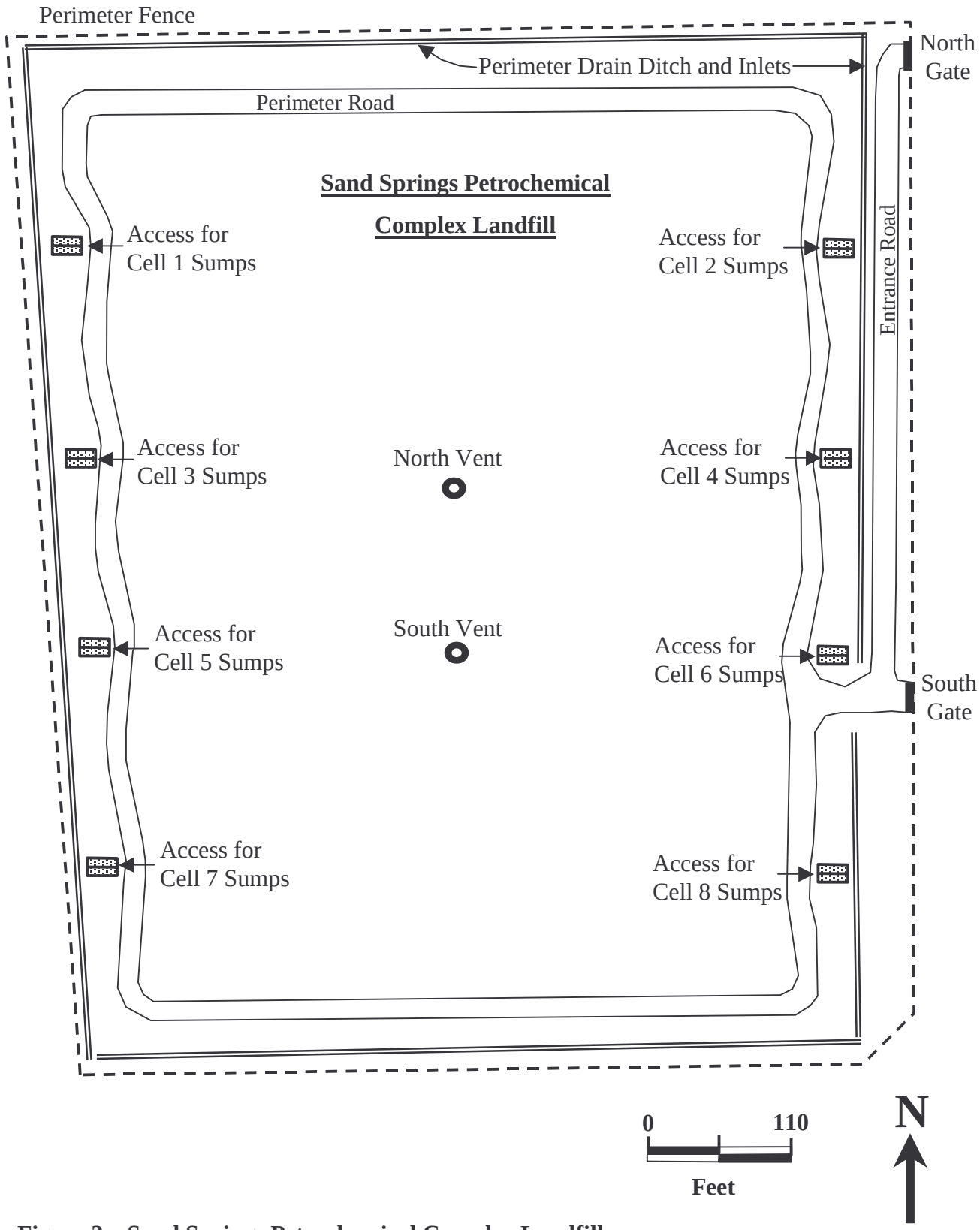


Figure 2 – Sand Springs Petrochemical Complex Landfill

2. LANDFILL SYSTEMS

2.1. Landfill Characteristics

The following landfill characteristics are relevant to site maintenance activities:

- The material deposited in the landfill consisted of treated sludge and treated, contaminated soils. These materials were treated by chemical solidification and stabilization. The material was deposited in eight separate cells in the on-site landfill, which was completed in 1995.

- The bottom of the landfill was constructed with a layered liner that consists of clay material and a synthetic liner system on the bottom and side slopes of the landfill. Enclosed in the liner system are two separate leachate systems that collect leachate. The upper system is referred to as the leachate collection system; the lower system is referred to as the leachate detection system.

- After the treated wastes were placed in the landfill, a cover system was constructed. The cover system consists of a HDPE synthetic cover overlaid by a drainage fabric, which is overlaid by subsoil and topsoil. The drainage fabric and liner intercept water seeping through the topsoil and subsoil layers, and the collective flow is directed laterally to discharge just below the crest of the landfill perimeter.

- Leachate generated by each of the eight cells is directed to a separate sump that retains the liquid. Each sump can be accessed via pumps and riser pipes that are placed in concrete enclosures located around the perimeter of the landfill. There are eight sumps and enclosures for the collection system and a corresponding number for the detection system. A road is located at the perimeter of the landfill and is used to access the concrete enclosures. The locations of the features are shown in Figure 2.

- A gas vent system was installed that utilizes the synthetic cover as a barrier, and includes two risers located at the south apex and north apex of the landfill. The vent system is designed to release potential gases to the atmosphere.

- Ten monitoring wells surrounding the landfill are utilized to monitor groundwater for the site.

- A perimeter fence is maintained to provide site security for the landfill.

2.2. Leachate Collection and Detection System

The landfill is equipped with a leachate detection and collection system. The following items provide an overview of the system:

- Each of the eight landfill cells has a separate leachate collection and detection system. The leachate collection system is located above the leachate detection system. The leachate collection system directly receives leachate that infiltrates through the waste. The leachate detection system receives leachate that leaks past the collection system. The system in each cell is graded to drain to a sump that contains a riser pipe for leachate removal. The riser pipe is accessed via concrete enclosures located on the perimeter of the landfill. Periodically, leachate is pumped into a transfer tank, sampled, and discharged under permit to the Sand Springs POTW.

- The leachate removal system consists of a riser casing, an electric submersible pump, pipe, and electrical accessories and fittings. A similar system is installed in each of the 16 collection and detection concrete enclosures. The systems have a design pumping rate of 40 gallons per minute. The pumping system components can be removed for maintenance and inspection.

- Leachate detection and collection procedures are detailed in Section 7 – Landfill Leachate Collection Procedures. The disposal of leachate to the Sand Springs POTW is discussed in Section 7.2.

2.3. Groundwater Monitoring System

The landfill groundwater monitoring network contains nine wells. Monitor wells MW-14 and MW-15 are located up gradient approximately 500 feet northwest of the landfill. Monitor wells MW-101, MW-102, and MW103 are located up gradient at the perimeter of the landfill cells on the north and west sides. Monitor wells MW-104 and MW-105 are located down gradient at the perimeter of the landfill cells on the east side. Monitor wells MW-106 and MW-107 are located down gradient on the levee on the south side of the landfill.

An additional groundwater well is located 1,500 feet east of the landfill and 50 feet south of the Arkansas River Levee. This well is designed to monitor the former Glen Wynn pits, which were excavated during the remedial action for the site.

Groundwater flow is from northwest to southeast. The monitoring well network, monitoring procedures, sample handling procedures, laboratory analysis program, and reporting requirements are described in Section 8 – Landfill Groundwater Monitoring.

3. ORGANIZATIONS INVOLVED IN SITE MAINTENANCE ACTIVITIES

3.1. Sand Springs Home

The property owner is the Sand Springs Home. The Sand Springs Home has granted the Oklahoma DEQ access to the property for maintenance and inspection (see Appendix C). Under this agreement, Atlantic Richfield will conduct monitoring and maintenance at the site.

3.2. Atlantic Richfield

Atlantic Richfield is responsible for conducting landfill inspection, maintenance, and groundwater monitoring activities, and for providing the USEPA and Oklahoma DEQ with reports that document those activities.

The Atlantic Richfield site manager responsible for the Sand Springs site is:

Terry J. Moore	**Telephone:**	**(972) 509-7006**
Atlantic Richfield Company	**Facsimile:**	**(972) 422-6450**
1701 Summit Ave., Suite 2	**Cell:**	**(214) 505-3992**
Plano, TX 75074	**Email:**	**mooretj1@bp.com**

3.3. Oklahoma Department of Environmental Quality (Oklahoma DEQ)

The Oklahoma DEQ is located in Oklahoma City, Oklahoma. The state agency provides oversight of O&M activities.

3.4. United States Environmental Protection Agency (USEPA) Region 6

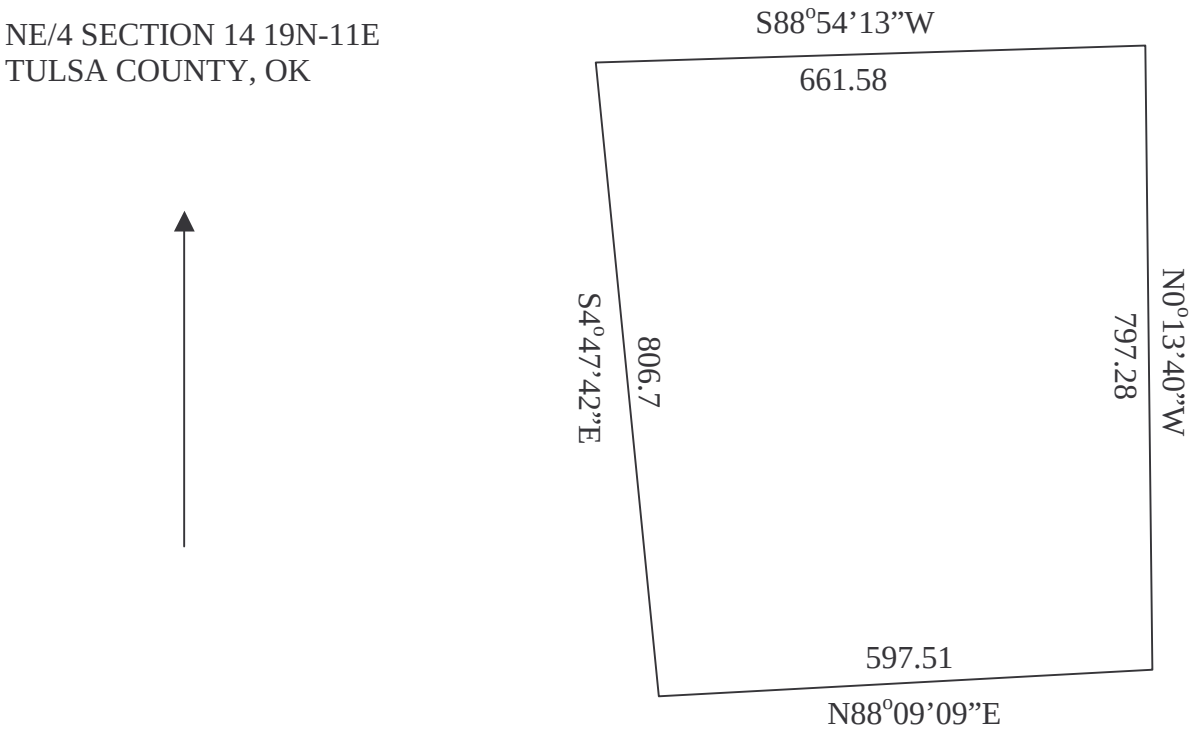
The USEPA Region 6 office is located in Dallas, Texas. The USEPA is the lead agency and provides oversight of O&M activities.

3.5. Tulsa District United States Army Corp of Engineers (USACOE)

The Tulsa District office of the Corp of Engineers is responsible for access and permits for activities that occur on the levee structure and in the flood plain and channels of the Arkansas River. The agency provides technical assistance to the EPA.

3.6. Surveyed Plot of the Landfill

The following surveyed plot of the landfill (Figure 3) has been submitted to ODEQ, EPA, and the City of Sand Springs.



A piece, parcel or tract of land located in the North Half of the Northeast quarter and Fractional Lot 1 of Section 14 Township 19N, Range 11E, Tulsa County, Oklahoma, more particularly described as follows:

Beginning at a point 616.73 feet South and 273.00 West of the Northeast Corner of said Section; Thence S 88 deg 54'13" W a distance of 661.58 feet to a point, said point being 614.28 feet South and 934.58 feet West of the Northeast Corner of said Section; Thence S 04 deg 47'42" E a distance of 806.70 feet; Thence N 88 deg 09'09" E a distance of 597.51 feet; Thence N 00 deg 13' 40" W a distance of 797.28 feet to the point of beginning.

Figure 3 – Survey Plot of the Landfill

4. SITE SECURITY AND ACCESS

The landfill is secured by a chain-link security fence surrounding the site. Two entrances with lockable gates will be maintained during the 30 year O&M period. Access gates will be locked except during O&M activities or as otherwise required by the responsible parties. Signs that are posted will be maintained to warn potential intruders and to prohibit trespass.

The site manager will inspect the fence and gates periodically to ensure they are intact and in good repair. Neighboring businesses, City of Sand Springs Police Department, and the Tulsa County Sheriff's Department will also be asked to observe and report the presence of unauthorized persons or vandalism at the site.

5. SITE AND LANDFILL INSPECTIONS

A site and landfill inspection is designed to identify conditions that:

- Indicate a site system is not performing properly.
- Interfere or might interfere with the proper operation of a site system.
- Suggest the occurrence of trespassing, tampering, or vandalism.

Site inspections will be performed quarterly. Conditions that require a significant action must be recorded and included in the annual report.

5.1. Landfill Inspection Procedures

5.1.1. Cover and Side Slopes

Inspect for the following conditions, irregularities or deficiencies:

- **Stability of the Landfill Cover** - Inspect the landfill cover and side slopes by walking over the surface and observing every part of the area. Look for surface deformations that might indicate slope movement or excessive differential settlement. Sight along grade breaks and look for horizontal or vertical deviations that indicate misalignment. Look for bulges or depressions in planar surfaces. Examine and document irregular or deficient conditions.
- **Inadequate Vegetation Coverage** - Ensure that the cover and side slopes are completely covered by specified vegetation. Denuded areas should be assessed and corrected following the directions in Section 6.1.1 of this document.
- **Animal Burrows** - Ensure that the cover is free of burrowing rodents that could cause damage to the landfill. Look for signs of burrow entrances and tunnels. Soft mounds of soil and tunnel tracks usually indicate the presence of pocket gophers or similar

burrowing animals. Eliminate burrowing rodents as needed using methods described in Section 6.1.1.

- **Erosion** - Ensure that the cover and side slopes are stable and free of erosion features. Direct special attention to the side slopes. Erosion features will usually start at slope breaks. Inspect the cover drains located below the shoulder of the perimeter road. Repair erosion damage in vegetated areas by filling channels with topsoil and planting appropriate varieties. Repair damaged drains as necessary to provide proper drainage and prevent debris from entering the drains.

- **Settlement and Subsidence** - Insure the cover is not settling excessively. Look for low spots where ponding can occur. Visible indications include ponding water or water marked vegetation. Repair areas prone to ponding by filling depressions with topsoil and replanting. Look for transverse cracks across the road or elsewhere in the cover.

- **Rutting** - Check the perimeter road for ruts and any indication of water ponding. Repair ruts with crushed rock and insure that the road will allow positive drainage from the landfill cap.

- **Slope Stability** - Ensure that the perimeter of the landfill maintains proper drainage grades. Visually sight along the toe of the slope and the crest to verify that the toe and crest are straight and have not moved. Look for longitudinal cracks along the road and cover. Look for topsoil sloughing or bulging that can be a sign of shallow slope failures. Repair slope deformations as required to maintain proper drainage and slope stability.

- **Landfill Survey** – Permanent benchmarks will be established outside of the landfill footprint on two concrete manhole vaults to be used as survey locations for the landfill. Benchmarks will be established within the landfill footprint on each of the 8 concrete leachate sump enclosures and on the two vents at the top of the landfill. A survey of the landfill will be conducted every 5 years utilizing the benchmarks to determine if settlement of the landfill has occurred.

5.1.2. Leachate Detection and Collection System

The landfill leachate collection and detection system for each cell is accessible through riser pipes contained within concrete enclosures. Each enclosure is covered by a steel protective grate that is bolted in place. Inspect for the following deficiencies:

- **Concrete Enclosures**. Ensure that the concrete enclosures are intact and undamaged by traffic, weather, or vandals. The grates should function to keep intruders away from the riser pipes and riser connection hardware. Ensure that the grates adequately cover the concrete vaults.

- **Labels**. Ensure that all enclosures are clearly and properly labeled with the cell number and leachate system type (e.g., "Collection" or "Detection").

- **Drainage Aggregate**. Insure that the drainage aggregate material within the concrete enclosure is free of weeds, trash, and debris. Insure that the aggregate is free draining with no visible signs of ponding, such as water marks or sediment lines.

- **Pipes and Connections**. Observe the pipes and connections. Production pipes should have a dust cap covering the end. Electrical cords and electrical boxes should not be cracked or otherwise damaged.

5.1.3. Gas Vents

Inspect the gas vent enclosures quarterly to insure they are intact, secure, and functional. Vent casings should be free of weeds, trash, and debris. At least once a year, open the covers and inspect the vent pipes themselves. Make sure the pipes are not clogged. Remove obstructions and any debris within the structures. Maintenance of the gas vents is reiterated in Section 6.1.2

5.2. Other Site Areas (Excluding the Landfill)

Areas on the site that were remediated during 2005-2006 will be visually inspected quarterly for five years. These areas will be inspected for excessive erosion, maintenance of proper surface drainage, appearance of exposed waste, and vegetative cover. Eroded soils or areas that do not

drain properly will be repaired or contoured in a manner consistent with good land management and conservation practice. The vegetation will be properly maintained to promote a self-sustaining cover.

Occasionally, small discrete deposits of waste material (tar or sludge) might become exposed and discovered during an inspection. On discovery, the waste materials will be excavated and collected following the procedures in Section 6.1.2. As a standard practice, all excavated locations will be backfilled with clean soil and properly contoured for drainage. Vegetation will be planted to promote a self-sustaining cover.

5.3. Fences and Gates

Walk the perimeter fence line and inspect for damaged or breeched sections. Ensure that fence posts are securely founded and chain link fabric is properly attached. Remove any wind-blown trash and debris. Vines and woody vegetation should not be allowed to grow on or into the fence fabric. Inspect all gates including: gate posts, braces, hinges and latches for secure attachment. The gates should swing freely and operate without obstruction. Verify that gate locks open and close easily and are secure.

5.4. Ditches and Drop Inlets

Drop inlets for the perimeter drain system surround the landfill and are located between the landfill side slopes and the perimeter fence. The purpose of the drop inlets is to convey surface water runoff from the landfill area to the city storm sewer. Locate all drop inlets within the landfill perimeter fence. Insure that ditches drain toward drop inlets as designed, and that drop inlets are free of vegetation, debris, and silt.

5.5. Miscellaneous Items and General Housekeeping

Insure that all trash and debris has been removed from the site. Observe the condition of the entrance road for rutting or water ponding. Insure that the warning sign on the entrance gate is

legible and in good condition. Correct any unsatisfactory conditions using good site management practices.

6. SITE MAINTENANCE PROCEDURES

Maintenance includes actions required to insure that the landfill and associated facilities maintain their integrity and continue to function as designed and constructed.

6.1. Landfill

6.1.1. Cover and Side Slopes

Grasses and other varieties of vegetation remove water that has infiltrated the topsoil layer of the cap by transpiration. Grasses also provides erosion protection on the top and side slopes.

- **General Requirements** - Correct any deficiencies discovered and documented during inspections.

- **Bare Spots** - Totally bare areas larger than 1 square yard should be repaired. Depending on the season and conditions, a locally adapted Bermuda grass cultivar is the preferred grass for repairing damaged or denuded areas on the cap. However, if temperature or moisture conditions are not favorable for Bermuda grass, other varieties of seasonal grasses may be used.

- **Burrowing Animals** - Burrowing animals can damage the synthetic liner and drain materials under the cover topsoil and subsoil layers. The effects of rodents should be minimized. Rodent control methods must be in compliance with state regulations (Title 35 OAC).

- **Mowing** - Mowing discourages woody plants and other deep rooted vegetation that can damage the underlying synthetic liner material. Mow the cover once each fall after October 1. Cut the vegetation stand to a 3 to 4 inch height. Cuttings will be left in place on the cover to form organic mulch. The practice of leaving the grass cuttings in place will be reviewed periodically. Removal of cover grasses by haying is an option open to Atlantic Richfield.

- **Weed Control** - The growth of undesirable woody plants or noxious weeds will be controlled as necessary. Such plants may be removed mechanically or by the application of approved broad-leaf, broad spectrum, and variety specific herbicides. Any herbicide application must comply with state regulations (Title 35 OAC).

- **Fertilizer** - To maintain vigor of the cover vegetation, an appropriately balanced nitrogen, potassium, and phosphate fertilizer blend may be applied to the site as necessary.

6.1.2. Gas Vents

During annual inspections, open the gas vent covers. Remove any foreign objects or debris. Insure the vents are not obstructed by debris, soil, vegetation, animal burrowing, or rodent nesting.

6.2. Characterization and Removal of Waste Detected in Other Site Areas

If small amounts of waste (less than 100 cubic yards) are discovered in an area outside the landfill perimeter, the following procedures will be utilized:

- Waste materials will be excavated and collected.
- Collected materials will be secured within the landfill perimeter fence until characterized.
- Materials will be sampled and analyzed for hazardous characteristics.
- After characterization, the secured waste will be disposed of properly in a manner consistent with state (Title 252 OAC) and federal (Title 40 CFR) regulations.

It is anticipated that any additional waste detected on the site will consist of small quantities of non-hazardous material. Typically, these materials will be collected by hand shovel, backhoe or front-end loader.

In the unlikely event a waste deposit greater than 100 cubic yards is detected, the following procedures will be utilized.

- Notify the regulatory agencies.
- Develop a characterization and excavation work plan for regulatory agency review..
- After work plan approval, the waste may be characterized, excavated, and disposed in a manner consistent with the approved work plan and state (Title 252 OAC) and federal (Title 40 CFR) regulations.

All excavated areas will be backfilled with clean soil and graded to properly drain.. Excavations or areas disturbed by removal work will be planted, monitored, and maintained until adequate vegetation is restored. On a routine basis, this maintenance activity will be described in the quarterly reports. Physical locations and quantities of materials removed will be documented in the Annual Report.

6.3. Fences and Gates

Repair any cuts, tears, or sagging in the perimeter fence. Repair gates as needed to maintain proper operation and secure the site. Replace locks that do not work properly or are not secure.

6.4. Ditches and Drop Inlets

Grade ditches as needed to insure proper drainage toward drop inlets. Clean drop inlets as required.

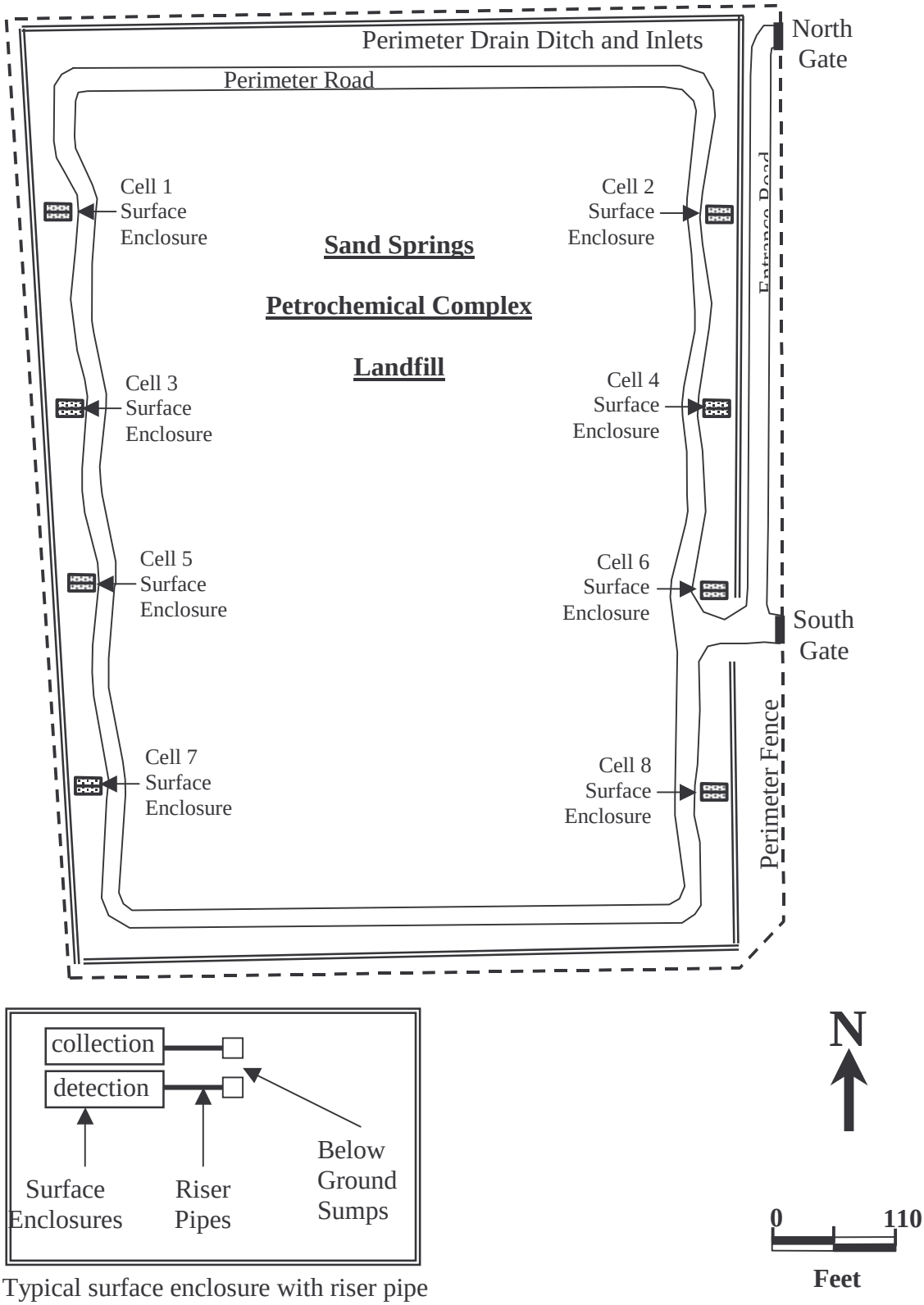
7. LANDFILL LEACHATE COLLECTION PROCEDURES

Periodically, landfill leachate will be removed from the leachate collection and detection systems. This section describes removal and disposal procedures for servicing the leachate collection and detection system:

7.1. Leachate System

The leachate collection and detection system piping for each cell drains to a separate sump located at the bottom edge of the landfill. Each sump is accessed via 12 inch diameter riser pipes that angle upwards from the below ground sump and emerge in concrete enclosures at the edge of the landfill. Within each leachate collection and detection enclosure, an electric pump is positioned in the sump at the bottom of the riser pipe. The pump is connected to a two inch diameter stainless steel production pipe and connections are provided at the top of the pipe so leachate can be pumped into a portable transfer tank.

Each enclosure is equipped with an electrical box, circuit breakers and an electrical connection. During operation, a portable generator is connected to the electrical box and the sump pump is electrically driven by the generator. A volume flow meter is connected between the end of the stainless steel production tubing and the output hose that discharges the leachate into the portable holding tank. The flow meter is utilized to measure the quantity of leachate that is pumped from the sump into the portable tank.



Typical surface enclosure with riser pipe and below ground sump

Figure 4 – Landfill Cells and Leachate Detection and Collection Sumps and Enclosures

The following procedure describes the activities.

1. Install the volume flow meter on the stainless steel production pipe. Connect one end of the transfer hose to the volume flow meter and the other end to the transfer tank.

2. Connect the cable from the portable generator to the electrical circuit breaker box cable coupling.

3. Start the generator engine and energize the electrical system circuit breakers to begin pumping.

4. Immediately check the flow meter. After flow is verified, continue to observe pumping rate and liquid level in the tank.

5. Verify that hoses and connections do not leak during pumping operations.

6. Test and calibrate the flow meter if this is the first pumping sequence of the leachate collection event. Meter calibration is performed only on the first pumping sequence of a leachate collection event.

    a. Record the reading on the flow meter when liquid level in the tank reaches 200 gal.

    b. Calculate the flow meter error using Eq.1.

% Error =	$\frac{200 - (\text{meter}_{\text{at tank 200}} - \text{meter}_{\text{at tank zero}})}{200 \text{ gallons}}$	Eq 1

    c. If percent error is less than or equal to 5%, the meter is properly calibrated for this leachate collection event.

    d. If the percent error I greater than 5%, stop pumping. Repair, recalibrate or replace the flow meter.

7. Pump the sump until the flow stops. Turn the pump off. Observe the flow meter reading. Wait five minutes and restart the pump.

8. When flow stops again, turn the pump off and record the gallons reading on the flow meter. If more than 10 gallons of leachate are removed, repeat the pumping sequence. The sump is considered empty when less than 10 gallons are removed after a single pumping interval.

9. Turn the generator off and disconnect the power cable before disconnecting the transfer hose.

10. Disconnect the transfer hose and flow meter, and replace the dust cap.

11. Clean and remove trash and debris from within the concrete vault and vicinity.

12. Replace the grate coverings.

13. Verify that the tansfer tank has sufficient capacity remaining to continue leachate collection operations.

    a. A leachate batch is an amount collected in the transfer tank prior to testing and disposal. Leachate is disposed per the batch disposal procedure in Section 7.2.

    b. If the tank is not filled to working capacity, continue to the next pump enclosure.

14. Repeat the pumping sequence for all cells and pump enclosures in the landfill.

7.2. Leachate Batch Disposal Procedure

1. The effluent is discharged to the sanitary sewer under a permit issued by the City of Sand Springs POTW.
2. It is necessary to receive permission from the City of Sand Springs POTW to discharge leachate during the day.

3. Measure the pH of the leachate batch in the holding tank.
    a. If the pH is less than 10 and greater than 5, the leachate may be discharged to the Sand Springs POTW.
    b. If the pH of the batch is greater than 10 or less than 5, the pH must be adjusted to meet the requirements of the Sand Springs POTW. If the pH is greater than 10, add an appropriate amount of hydrochloric or muratic acid to the batch to neutralize the pH. If the pH is less than 5, add bleach to the batch to neutralize the pH. The final pH of the batch must be between 5 and 10 prior to discharge to the Sand Springs POTW.

4. Continue leachate collection operations and repeat this procedure until leachate disposal is complete.

7.3. Collection and Removal Frequency

Each primary collection and detection sump system has a 560 gallon capacity at one foot of liquid head. Under normal operations, leachate collection and removal frequency is determined by comparing the amount of leachate removed to the 560 gallon sump capacity.

Infiltration into the sumps is expected to decrease with time. The frequency of collection and removal can be decreased over time when it can be shown that the infiltration rate will not exceed sump capacities over the time interval between leachate removal activities.

7.4. Action Leakage Rate Calculation and Notification Procedures

Leachate detection cells have a specified Action Leakage Rate (ALR) that is calculated after each leachate collection event. Procedures for ALR calculations are described in the following sections. If the ALR is exceeded for a detection sump, it is an indication that a failure in the leachate collection system has occurred. Collection and removal frequency will be increased if the detection sump ALR is exceeded.

Utilizing the information on Form 1 – Landfill Leachate Pumping Form, calculate the leachate removed from each detection sump in units of gallons per acre per day (GPAD) utilizing Eq. 2.

$GPAD = \frac{\text{Total Gallons Removed per cell}}{\text{(Area per cell in acres)(days between pumping events)}}$	Eq 2

The ALR for the detection sumps is 560 gallons per acre per day. (Calculation 51-52-L-040, Action Leakage Rate, *Consolidated Final Design Report - Volume III, Landfill Design, November 1993*. If the ALR is exceeded, the following procedure will be followed:

1. Within 7 days, the Oklahoma DEQ and USEPA will be notified that the ALR has been exceeded and indicate the affected cell(s).

2. Within 14 days of the determination, a preliminary written assessment will be submitted to the Oklahoma DEQ and USEPA regarding the amount and source of the leachate in the detection sump. If the excess leachate appears to be due to leakage through the cap, provide information on the possible size, location, and cause of the infiltration problem. Indicate the immediate and short-term actions to be taken (e.g., additional pumping to remove leachate and changes in operating practices to reduce leakage.)

3. Continue monthly reporting as long as the ALR is exceeded.

4. When corrective actions have been successful, submit a report to the Oklahoma DEQ and USEPA describing how the final response actions have been effective.

8. LANDFILL GROUNDWATER MONITORING

The objective of site groundwater monitoring is to assure groundwater protection and demonstrate the effectiveness of the landfill remedy. The groundwater monitoring program will be conducted in accordance with this plan, applicable standard operating procedures (SOPs), and the site Specific Health and Safety Plan.

8.1. Monitoring Program

8.1.1. Monitoring Well Locations

Ten monitor wells will be used to monitor groundwater at the site. Nine monitor wells will be utilized to monitor groundwater up gradient and down gradient of the landfill. The tenth monitor well will be utilized to monitor groundwater down gradient of the Glen Wynn portion of the site. The wells are labeled MW-14, 15, 101, 102, 103, 104, 105, 106, 107, and 119. The surface location of each well is depicted in Figure 4.

MW-14 and MW-15 are located up gradient from the landfill toward the northwest corner boundary of the Sand Springs Petrochemical Complex. These two wells are expected to provide background data for groundwater flowing onto the site from up gradient areas.

MW-101, MW-102, and MW-103 are located immediately up gradient on the perimeter of the landfill. Wells MW-101 and MW-102 are on the west side of the landfill. Well MW-103 is on the north side.

MW-104 and MW-105 are located east of the landfill on the down gradient perimeter. Wells MW-106 and MW-107 are located down gradient south of the landfill. The flush well head surface locations of MW-106 and MW-107 are on the Arkansas River levee structure.

MW-119 is located south of the levee approximately 600 feet east of the landfill. The well is positioned to monitor ground water down gradient of previously excavated North and South pit on the Glen Wynn portion of the site.

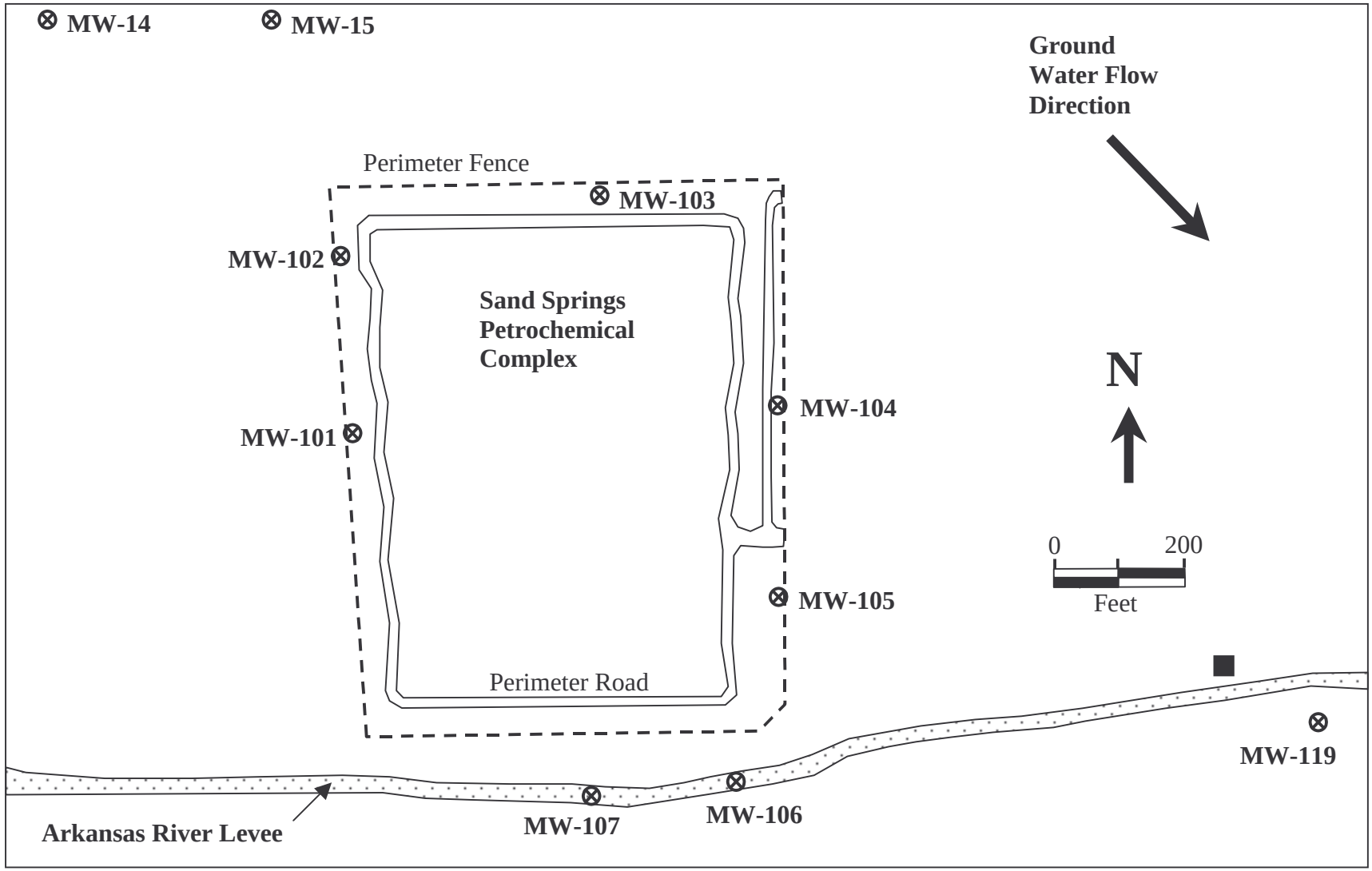


Figure 5 – Groundwater Monitoring Well Locations

8.1.2. Analytical Requirements

Groundwater samples will be tested for the indicator and field parameters listed in Table 1, and analyzed for the constituents listed in Table 2 (metals), Table 3 (volatile organic compounds), and Table 4 (semi-volatile organic compounds including base, neutral, and acid extractable parameters). These constituents have been identified by analysis of previously collected groundwater, soil, and other media samples. In addition, field parameters recorded at each well will include Total Dissolved Solids, pH, electrical conductivity, and temperature.

Table 1 –Groundwater Monitoring –Field Parameters

Analytes	Method
Total Dissolved Solids	EPA 3010/6010 (ICP Water)
pH	EPA 3010/6010 (ICP Water)
Specific Conductance	EPA 3010/6010 (ICP Water)
Temperature	EPA 3010/6010 (ICP Water)

Table 2 –Groundwater Monitoring Analytes – Metals

Analytes	Method
Antimony	EPA 3010/6010 (ICP Water)
Arsenic	EPA 3010/6010 (ICP Water)
Barium	EPA 3010/6010 (ICP Water)
Beryllium	EPA 3010/6010 (ICP Water)
Cadmium	EPA 3010/6010 (ICP Water)
Chromium	EPA 3010/6010 (ICP Water)
Copper	EPA 3010/6010 (ICP Water)
Lead	EPA 3010/6010 (ICP Water)
Mercury	EPA 7470 (CVAAS)
Nickel	EPA 3010/6010 (ICP Water)
Selenium	EPA 3010/6010 (ICP Water)
Silver	EPA 3010/6010 (ICP Water)
Zinc	EPA 3010/6010 (ICP Water)

Table 3 –Groundwater Monitoring Analytes – Volatile Organic Compounds (GC/MS)

Analytes (Common Nomenclature in Parenthesis)	CAS No.	Method
2-Propanone (Acetone)	67-64-1	EPA 8260
Benzene	71-43-2	EPA 8260
Benzene, 1, 2-dimethyl (*o*-Xylene)	95-47-6	EPA 8260
Benzene, 1, 3-dimethyl- (*p*-Xylene)	106-42-3	EPA 8260
Benzene, 1, 3-dimethyl- (*m*-Xylene)	108-38-3	EPA 8260
Benzene, Ethyl-	100-41-4	EPA 8260
Benzene, methyl- (Toluene)	108-88-3	EPA 8260
Ethane, 1, 1, 1-trichloro- (Methyl chloroform, TCA)	71-55-6	EPA 8260
Ethane, 1, 1, 2-trichloro-	79-00-5	EPA 8260
Ethane, 1, 1-dichloro- (Ethylidene dichloride)	75-34-3	EPA 8260
Ethane, 1, 2-dichloro- (Ethylene dichloride)	107-06-2	EPA 8260
Ethane, chloro- (Ethyl chloride)	75-00-3	EPA 8260
Ethene, 1, 1-dichloro- (Vinylidene chloride)	75-35-4	EPA 8260
Ethene, 1, 2-dichloro, (*E*)- (*trans*-1, 2-dichloroethene)	156-60-5	EPA 8260
Ethene, chloro- (Vinyl chloride)	75-01-4	EPA 8260
Ethene, tetrachloro- (Tetrachloroethylene, PCE)	127-18-4	EPA 8260
Ethene, trichloro- (Trichloroethylene, TCE)	79-01-6	EPA 8260
Methane, chloro- (Methyl chloride)	74-87-3	EPA 8260
Methane, dichloro- (Methylene chloride)	75-09-2	EPA 8260
Methane, trichloro- (Chloroform)	67-66-3	EPA 8260

Table 4 –Groundwater Monitoring Analytes – Semi-volatile Compounds (GC/MS)

Analytes (Common Nomenclature in Parenthesis)	CAS No.	Method
Base-Neutral Extractable Compounds		
Anthracene	120-12-7	EPA 3510/8270
Benzo[*a*]anthracene (1, 2-Benzanthracene)	56-55-3	EPA 3510/8270
Benzo[*a*]pvrene (2, 3-Benzopyrene)	50-32-8	EPA 3510/8270
Benzo[*b*]f1uoranthene (Benz[*e*]acephenanthrylene)	205-99-2	EPA 3510/8270
Benzo[*k*]fluoranthene (2, 3, 1′, 8′-Binaphtylene)	207-08-9	EPA 3510/8270
1, 2-Bezenedicarboxylic acid, bis(2-ethylhexyl) ester (Bis(2-ethvlhexvl) phthalate)	117-81-7	EPA 3510/8270
Chrvsene (1, 2-Benzophenanthrene)	218-01-9	EPA 3510/8270
Dibenzofuran (2, 2-Biphenylene oxide)	132-64-9	EPA 3510/8270
1, 2-Bezenedicarboxylic acid, dimethyl ester (Dimethvl Phthalate)	131-11-3	EPA 3510/8270

1, 2-Bezenedicarboxylic acid, dibutyl ester (Di-n-butvl Phthalate)	84-74-2	EPA 3510/8270
9H-Fluorene (2, 2′-Methylenebiphenyl)	86-73-7	EPA 3510/8270
Naphthalene, 2-methyl- (2-Methvlnaphthalene)	91-57-6	EPA 3510/8270
Naphthalene	91-20-3	EPA 3510/8270
Phenanthrene	85-01-8	EPA 3510/8270
Pvrene (Benzo[*def*]phenanthrene)	129-00-0	EPA 3510/8270
Acid Extractable Compounds		
Benzoic acid (Benzenecarboxylic acid)	65-85-0	EPA 3510/8270
Phenol, 4-chloro-3-methyl- (*p*-Chloro-*m*-cresol)	59-50-7	EPA 3510/8270
Phenol, 2, 4-Dimethvl- (2, 4-Xylenol	105-67-9	EPA 3510/8270
Phenol, 2-methyl-4, 6-dinitro- (4, 6-Dinitro-*o*-cresol)	534-52-1	EPA 3510/8270
Phenol (Hydroxybenzene)	108-95-2	EPA 3510/8270

8.1.3. Groundwater Monitoring Evaluation

Monitor well analytical data generated by laboratory samples will be presented in the annual report. The current and historical data will be examined to determine if the data exhibits increasing or decreasing trends. Observable trends will be noted in the annual report. If potentially significant increasing trends are observed, an objective statistical test procedure will be applied to the time series data. The Mann-Kendall statistic is designed to test the null hypothesis of randomness and will be the statistical test utilized to examine the time series data for increasing or decreasing trends.

8.1.4. Monitoring Frequency and Schedule

The groundwater sampling schedule and frequency described in Table 5 will be used during the 30 year operation, maintenance, and monitoring period.

Table 5 – O&M 30 year groundwater sampling schedule.

Monitor wells MW 14, 15, 101, 102, 103, 104 105 106 107		Monitor well MW 119	
Date	**Frequency**	**Date**	**Frequency**
December 1995 March 1996	Semi-annual (Completed Sampling)		
June 1997 to June 2006	Annual (Completed Sampling)		
June 2007 to June 2025 June 2026 (Final)	Annual	June 2007 to June 2025 June 2026 (Final)	Annual

8.2. Field Methods for Groundwater Monitoring

Groundwater monitoring procedures are described in Standard Operating Procedures (SOP) included in Appendix B of this document

- SOP 140 – Decontamination
- SOP 150 – Chain-of-Custody, Documentation, Packaging and Shipment of Samples
- SOP 190 – Groundwater Sampling Best Practice and Procedures
- SOP 240 – Groundwater Level Measurements

8.3. Reporting

Results derived from groundwater sampling activities will be reported as described in Section 11.1 Annual Reports.

9. QUALITY ASSURANCE/QUALITY CONTROL

9.1. Data Quality

As part of the sampling program, quality assurance and quality control (QA/QC) procedures will be implemented to ensure the precision, accuracy, and completeness of analytical results. Data QA/QC parameters to be evaluated include:

- Data precision - a measure of variability between individual sample measurements. Precision is determined through the analysis of field duplicate samples, field blanks, and trip blanks.
- Data accuracy - the degree of agreement between a measurement and an accepted reference or true concentration. To determine the accuracy of an analytical method, a laboratory spiking program will be conducted.
- Data Completeness - a measure of the amount of data actually collected, analyzed, and validated compared to the amount specified in this plan. Completeness is the ratio of samples planned to valid analyses received.

Each phase of the monitoring program including field work, laboratory analyses, and data evaluation and reporting will include data QA/QC protocol. The complete QAPP is presented in Appendix E.

9.1.1. Field Quality Assurance/Quality Control

During any sampling or measurement activity, QA/QC procedures will be followed in accordance with the SOPs provided in Appendix B. The SOP's that provide guidance for field QA/QC activities include:

- SOP 140 – Decontamination
- SOP 150 – Sample Documentation, Packaging and Shipment

- SOP 190 – Groundwater Sampling
- SOP 240 – Groundwater Level Measurements

Field duplicates for all sampling activities will be collected at a frequency of 1 duplicate for every 10 samples.

9.1.2. Laboratory Quality Assurance/Quality Control

The analytical laboratory will conduct analysis of samples based on EPA Contract Laboratory protocol. References for CLP analytical methods can be found in USEPA Contact Laboratory Program Statement of Work for Organic Analysis (OLM04.2 May 1999).

9.1.3. Quality Assurance/Quality Control Data Validation

Atlantic Richfield will insure that analytical data will be evaluated for precision, accuracy, and completeness.

10. RECORD KEEPING

The Atlantic Richfield Company will maintain a file of the following records:

- Copies of site characterization documents.
- Copies of design documents.
- Copies of remediation and construction documents including as-built drawings, construction reports, and QA/QC records.
- Operation Maintenance and Monitoring Plan.
- All maintenance records including leachate collection and flow meter calibration forms.
- Groundwater monitoring records and test reports.
- All inspection records including annual inspection reports.
- Photographs of deficiencies along with completed corrective actions. Yearly panoramic views of the various site areas. All photographs will be dated and labeled.

11. REPORTS

11.1. Annual Reports

Each year, Atlantic Richfield Company will prepare and submit an annual report to the Oklahoma DEQ and USEPA Region 6. The annual report will contain the following information:

- A description of the results of inspections describing actions completed and a list of pending actions along with a schedule for completion.
- Copies of completed Form 1 – Landfill Leachate Pumping Form for each cell sump.
- The calculated ALR.
- Tabulation and analysis of groundwater sampling results and analysis.

11.2. Special Reports

ARCO will notify Oklahoma DEQ and USEPA regarding significant deficiencies including exceeding the ALR, serious erosion, and slope failure. The report will describe the nature and extent of the deficiency, provide information on possible causes, and indicate the immediate and short-term actions to be taken. When corrective actions are successful, Atlantic Richfield Company will submit a report to Oklahoma DEQ and USEPA describing how the final response has been successful.

11.3. O&M Completion Report

Within 60 days after the end of the 30 year O&M period, Atlantic Richfield Company or its representative will notify the USEPA and the Oklahoma DEQ by registered mail that O&M activities are complete. The letter will certify that O&M activities were conducted in accordance with this approved O&M plan. The certification letter will be signed by an Atlantic Richfield Company or descendant company officer. Documentation attesting to and supporting the certification will be provided upon request.

Appendix A

Blank Forms

- Form 1–Landfill Leachate Pumping Form Source Control Operable Unit, Sand Springs Site, OK

Form 1 – Landfill Leachate Pumping Form

Source Control Operable Unit, Sand Springs Site, OK

Date: _____ **Cell Number:** _____

Weekday: _____

☐ Collection Sump

☐ Detection Sump

Table 1–Data

Pumping Sequence	Flow Meter Reading Before Pumping [a]	Time [b]	Flow Meter Reading After Pumping [c]	Time [d]	Gallons Removed *(Column C - Column A)*	Notes
1st						Wait 5 minutes and repeat procedure.
2nd						If more than 30 gal. are removed by 2nd pumping, repeat procedure. Otherwise, pumping is complete.
3rd						If more than 30 gal. are removed by 3rd pumping, repeat procedure. Otherwise, pumping is complete.
4th						If more than 30 gal. are removed by 4th pumping, repeat procedure. Otherwise, pumping is complete.
Total Gallons Removed						

Table 2–Cell Areas (acres)

Cell Number	Cell Area (acres)
1	1.135
2	1.139
3	0.890
4	0.899
5	0.869
6	0.881
7	1.113
8	1.108

Appendix B

SOP’s

SOP 140 – Decontamination

1.0 Purpose and Applicability

This SOP describes the methods to be used for the decontamination of items that may become contaminated during field operations. Decontamination is performed as a quality assurance measure and as a health and safety precaution. It prevents cross-contamination between samples and also helps maintain a clean working environment. The equipment requiring decontamination may include hand tools, monitoring and testing equipment, personal protective equipment, or heavy equipment (e.g., loaders, backhoes, drill rigs, etc.).

Decontamination is usually achieved by washing and rinsing equipment with liquids like soap, detergent solutions, tap water, distilled water, and methanol. Equipment may be allowed to air dry after being cleaned or may be wiped dry with paper towels or chemical free cloths.

All sampling equipment will be decontaminated prior to use and between each sample collection point. Waste products produced by the decontamination procedures such as rinse liquids, solids, rags, gloves, etc. will be collected and disposed of properly based on the nature of contamination and following site protocols. Any materials and equipment that will be reused must be decontaminated or properly protected before being removed from the site.

Specific project requirements described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

2.0 Responsibilities

It is the responsibility of the field project manger to ensure that the proper decontamination procedures are followed and that all waste materials produced by decontamination are properly managed. It is the responsibility of any subcontractors (e.g., drilling or sampling contractors) to follow the proper designated decontamination procedures that are stated in their contracts and outlined in the site specific health and safety plan. It is the responsibility of all personnel involved with sample collection or decontamination to maintain a clean working environment and to ensure that no contaminants are negligently introduced into the environment.

3.0 Supporting Materials

The following materials should be available at the work site and in sufficient quantity to ensure that proper decontamination methods and procedures are followed:

- Cleaning liquids and dispensers (soap or detergent solutions, tap water, distilled water, methanol, or isopropyl, etc.);
- Personal safety gear as defined in the project health and safety plan;
- Paper towels or chemical-free cloths;
- Disposable gloves;
- Waste-storage containers (drums, boxes, plastic bags);
- Container labels;
- Cleaning containers (plastic or galvanized steel pans or buckets);
- Cleaning brushes; and
- Plastic sheeting.

4.0 Methods and Procedures

The extent of known contamination will determine the degree of decontamination required. If the extent of contamination cannot be readily determined, cleaning should be done according to the assumption that the equipment is highly contaminated. The standard procedures listed below describe the method for field decontamination. If different technical procedures are required for a specific project, they will be detailed in the project plans. Variations in decontamination may include all or an expanded scope of the decontamination procedure stated in this SOP.

- Remove gross contamination from the equipment by brushing and then rinsing with tap water.
- Wash with a detergent or soap solution (e.g., Alconox and tap water).

- Rinse with tap water.
- Rinse with methanol or isopropyl.
- Rinse with distilled or deionized water.
- Repeat entire procedure or any parts of the procedure as necessary.
- After the decontamination procedure is completed, avoid placing equipment directly on ground surface to avoid contaminating again.

Down-hole drilling equipment, such as augers, split spoons, Shelby tubes, and sand lines, will be decontaminated with a pressurized hot water or steam wash followed by a fresh water rinse. No additional decontamination will be required if the equipment appears visually clean. If contamination is visible after hot water/steam cleaning, a detergent wash solution and brushes (if necessary) will be used.

5.0 Quality Assurance and Quality Control

To assess the effectiveness of decontamination procedures, rinse solution blanks should be collected and analyzed for the same parameters as the field samples. In general, one rinse solution blank will be collected per ten samples.

6.0 Documentation

Field notes describing the procedures used to decontaminate equipment/personnel and to collect the rinse solutions samples will be documented by on-site personnel. These field notes will be kept in the project files.

SOP 150 –SAMPLE DOCUMENTATION, PACKAGING AND SHIPMENT

1.0 PURPOSE AND APPLICABILITY

This SOP describes methods for packaging and shipment of samples to minimize the potential for sample breakage, leakage, or cross contamination, and to provide a clear record of sample custody from collection to analysis. Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

The EPA RCRA regulations (40 CFR Section 261.4 [d]) specify that samples of solid waste, water, soil, or air collected for the purpose of testing are exempt from regulation when any of the following conditions apply:

- Samples are being transported to a laboratory for analysis;
- Samples are being transported to the collector from the laboratory after analysis; and,
- Samples are being stored: (a) by the collector prior to shipment for analyses, (b) by the analytical laboratory prior to analyses, or (c) by the analytical laboratory after testing.

Samples collected at the site generally qualify for these exemptions. This SOP deals only with samples for analytical purposes.

2.0 RESPONSIBILITIES

The field project manger is responsible for the enactment and completion of the chain-of-custody record and for following the packaging and shipping requirements described in this SOP.

3.0 SUPPORTING MATERIAL

The following materials must be on hand in sufficient quantity to ensure that proper packaging and shipping methods and procedures may be followed:

- Chain-of-custody forms;
- Sealing tape;

- Sample container labels;
- Insulated boxes, ice chest coolers, or similar shipping containers;
- Zip-lock type bags of various sizes and adequate mil thickness to insure sample and document security;
- Protective wrapping and packaging materials;
- Ice or cold packs;
- Shipping labels for the exterior of the ice chest; and
- Transportation carrier forms (Federal Express, Airborne, etc.).

4.0 METHODS AND PROCEDURES

All samples must be packaged so that they do not leak, break, vaporize, or cause cross contamination of other samples. Waste samples and environmental samples (e.g., ground water, soil, etc.) should not be placed in the same container. Each individual sample must be properly labeled and identified. The sample shipment must be accompanied by a complete chain-of-custody record. When refrigeration is required for sample preservation, samples must be kept cool during the time between collection and final packaging.

All samples must be clearly identified immediately upon collection. Each sample bottle label should include the following information:

- Client or project name, or unique identifier, confidentiality statement;
- A unique sample description;
- Sample collection date and time;
- Sampler's name or initials;
- Indication of filtering or addition of preservative, if applicable; and

- Analyses to be performed.

After collection, identification, and preservation (if necessary), the samples will be maintained under chain-of-custody procedures as described below.

4.1 Chain-of-Custody

A sample is under custody if it is in one's possession, in one's view, or in a designated secure area. Transfers of sample custody must be documented by chain-of-custody (COC) forms. The COC record will include, at a minimum, the following information:

- Client or project name, or unique identifier;
- Sample collector's name;
- Company's mailing address and telephone number;
- Analytical laboratory's name and city;
- Description of each sample (i.e., unique identifier and matrix);
- Date and time of collection;
- Quantity of each sample or number of containers; and
- Type of analysis required.

Additional information may include type of sample containers, shipping identification air-bill number, etc. When transferring custody, the individual relinquishing custody of the samples and the individual receiving custody of the samples will sign, date, and note the time on the COC. If samples are to leave the collector's possession for shipment to the laboratory, the individual relinquishing custody will sign and date the COC.

4.2 Packaging for Shipment

To prepare a cooler for shipment, the sample bottles should be inventoried and logged on the chain-of-custody form. At least one layer of protective material should be placed in the bottom of the container. A large plastic trash type bag should be placed in the cooler and all sample bottles and ice or cold packs should be placed in the bag. As each sample bottle is logged on the chain-of-custody form, it should be wrapped with bubble-wrap or similar protective packing material to prevent breakage. Each sample bottle should be placed upright in the shipping container. Each sample bottle cap should be checked during wrapping and tightened if needed. Avoid over tightening, which may cause the bottle cap to crack and allow leakage. Additional packaging material such as bubble wrap should be spread throughout the voids between the sample bottles.

Most samples require refrigeration as a minimum preservative. As a general rule, samples should be maintained at a temperature of 3°C or less. Reusable cold packs or ice should be distributed over the top of the samples to maintain refrigeration. Additional packing material should then be placed to fill the balance of the cooler or container.

Tie the top of the bag to seal the contents of the cooler inside the bag.

Place the original completed chain-of-custody record in a zip-lock type plastic bag and place the bag on the top of the contents within the cooler or shipping container. Alternatively, the bag may be taped to the underside of the container lid. Retain a copy of the chain-of-custody record with the field records.

Close the top of the shipping container and rotate or shake the container to verify that the contents are packed so that they do not move. Add additional packaging if needed and close.

Place a signed and dated custody seal on the cooler or container lid and overlap with transparent packaging tape. Two custody seals may be required on some shipping containers. Custody seals should be placed on the container in such a way that opening the container will destroy the tape. Packaging tape should encircle each end of the cooler at the hinges.

Impact or shock detectors can be added to the outside of the package to monitor for proper handling.

Sample shipment should occur via an overnight express service that can guarantee 24-hour delivery. Retain copies of all shipment records as provided by the shipping service.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

The recipient of the sample container package should advise the sender, shipping service or transporter immediately of any damage to container, breakage or leakage of contents, or evidence of tampering. The documentation related to the shipping event and receipt inspection must be maintained.

6.0 DOCUMENTATION

The documentation required for support of proper packaging and shipment will include the sampler's field notes, BP or the laboratory chain-of-custody record, the transportation carrier air-bill, and delivery invoice. All documentation will be retained in the project files.

SOP 190 – GROUNDWATER SAMPLING

1.0 PURPOSE AND APPLICABILITY

This SOP describes the collection of valid and representative samples from ground water monitor wells. Specific project requirements as described in an approved Work Plan, Field Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

2.0 RESPONSIBILITIES

The field project manger will have the responsibility to oversee and ensure that all ground water sampling is performed in accordance with the sampling program specified in this SOP.

3.0 SUPPORTING MATERIALS

The list below identifies the types of equipment that may be used for a range of ground water sampling applications. From this list, project specific equipment will be selected based upon project objectives and site conditions (e.g., the depth to ground water, purge volumes, analytical parameters, well construction, and physical or chemical properties of the analytes). The types of sampling equipment are as follows:

- Bailers and bailer cord;
- Centrifugal pump;
- Bladder pump; or
- Peristaltic pump.

The most widely applicable equipment that will contact the water must be made of inert materials, preferably PVC, stainless steel, or fluorocarbon resin. The material used will depend on the type of contaminants present in the ground water to be sampled.

Sample Preparation and Field Measurement Equipment:

- pH meter;
- Specific conductance meter;

- Thermometer;
- Filtration apparatus; and
- Ground water level measurement equipment.

All equipment will be calibrated before use by following the manufacturer's procedures and specifications.

The following general supplies may be required:

- Distilled water dispenser bottle;
- Decontamination equipment;
- Personal protection equipment as specified in the Health and Safety Plan;
- Field data sheets and field book;
- Sample containers, labels, and preservation solutions;
- Buckets and drums;
- Coolers and ice; and
- Paper towels or chemical free cloths.

4.0 METHODS AND PROCEDURES

The following sections describe the methods and procedures required to collect representative ground water samples.

4.1 Water-Level Measurement

After unlocking and opening a monitor well, the first task will be to measure the depth from the top of the well's casing to the stabilized ground water level. If the well has an air tight cap, after the air tight cap is removed, the well must be allowed to equilibrate with air pressure for approximately 5 minutes before measuring the water level. The stabilized ground water level will be measured in the well prior to the purging and collection of any samples. The water level is required for calculating the volume of water to purge from the well before sampling and may also be used for mapping the groundwater potentiometric surface. Ground water level measurements will be made using an electronic or mechanical device following the methods described in SOP 240.

The measuring point location for ground water level measurements should be clearly marked on the well casing or identified in previous sample collection records. This point is usually established on the well casing itself, but may be marked on the protective steel casing in some cases. In all cases, it is important that the marked point utilized for measurement coincide with the point elevation measurement used by the surveyor. If not marked from previous investigations, the water level measuring point should be marked on the north side of the well casing and noted in the ground water sampling form. Whatever measuring point is used, the location should be described on the ground water sampling form.

Water level measurements made with a steel tape should be repeated to ensure accuracy. If using an electronic unit, a meter, light or audible tone will indicate water contact, and a precise measurement should be determined by repeatedly raising and lowering the tape or cable to converge on the exact water level. The water level measurement should be entered on the ground water sampling form. After a stabilized water level has been measured, the total depth of the well should be measured and recorded on the sampling form. The water level measurement device must be decontaminated immediately after use following the procedures outlined in SOP 140.

4.2 Purging and Sample Collection Procedures

Well purging is the activity of removing a volume of water from a monitor well in order to induce “fresh” ground water to flow into the well from the aquifer prior to sampling. Under most well construction and hydrogeologic conditions, this procedure removes stagnant water from the well and fills the well with water from the saturated zone where the well is screened. The theory behind well purging assumes that fresh water from the saturated zone is more representative of the actual geochemical conditions in the aquifer than water that has been standing inside the well casing for several months.

The volume of water to be removed, referred to as the purge volume, is a function of the water-yielding capacity of the well, the well diameter and depth, and the depth to water made just prior to purging. The well depth should be sounded with the water-level cable or tape just before or after measuring the stabilized depth to water. A well volume is defined as the product of the

length of water column and the volume per unit length of well casing, based on the casing inside diameter. The following data can be used in this field calculation:

Inside Diameter, inches	Volume/Length, gallons/foot
2.0	0.16
3.0	0.37
4.0	0.65
6.0	1.64

According to the EPA Ground Water Technical Enforcement Guidance Document (TEGD, USEPA, 1986), the purge volume should equal at least three well volumes when the earth materials will yield relatively large quantities of water, and between one and two well volumes when the earth materials will only yield small quantities to the well. From a field operations viewpoint, large quantities (high yield) means that the well can not be pumped or bailed "dry" by removing three well volumes. Small quantities (low yield) are identified when the well can be pumped or bailed "dry".

Suspended solids are of special concern when testing the samples for metals that may be present in the suspended solids and may increase subsequent total metals analytical results. Suspended solids may increase or decrease the concentrations of organic chemicals by adsorption to or desorbing from suspended particles. Usually, suspended solids (turbidity) in ground water samples are fine sediments that have entered the well from the water bearing formation. The best way to reduce turbidity in ground water samples is (1) by proper well construction using the appropriate screen and filter pack size appropriate for the saturated zone grain size distribution, (2) by proper well development, and (3) by ground water sampling methods that reduce the turbidity of samples. As a general practice, turbidity will be minimized during ground water sampling by:

- Using a high flow rate pump to remove sediment that may have accumulated in a well before purging;

- Adequately purging the well before samples are collected. Note: Purging will be performed on all ground water monitor wells prior to sample collection.

- Micro purging using a low pumping rate peristaltic pump or a submersible pump such as a compressed-gas driven bladder pump;

- Slowly moving the bailer in and out of the water column during purging; avoid dropping the bailer and removing it quickly;

Three general methods are used for well purging. Well purging may be achieved using bailers, surface pumps, or down-well submersible pumps. In all cases, pH, specific conductance, and temperature will be monitored during purging. These field parameter values will be entered on the ground water sampling form along with the corresponding purge volume. Initial, middle, and final field measurements of the purge water will usually be taken during well purging. The following sections explain the procedures to be used to purge and collect samples from monitor wells.

4.2.1 Bailing

Obtain a new or clean decontaminated bailer and a spool of clear monofilament polypropylene line or equivalent bailer cord. Clear monofilament line is recommended since it will not bleed organic chemicals into the sample and is very economical. Attach the bailer by tying a secure knot through the bailer loop. Test the knot for security and tie again if needed.

After determining the appropriate line length needed for bailing, remove an additional five feet of line from the spool. Cut the line at the spool and secure to the well head or the wrist of the person who shall perform the bailing. Lift the bailer by grasping a section of line using each hand alternately. This lift method is used so the bailer line will not come into contact with the ground or other potentially contaminated surfaces.

Samples collected by bailing will be poured directly into sample containers from bailers that are full of fresh ground water. During sample collection, bailer contact with the sample containers will be avoided. Samples will be collected in the following order:

- Volatile organic compounds;
- Semi-volatile organic compounds;
- Pesticides/Herbicides/PCBs/Dioxins;
- Organic indicator compounds;
- Metals (total and/or dissolved);
- Miscellaneous inorganic compounds;
- Radiometric compounds; and
- Microbial analyses.

4.2.2 Pumping

Ground water withdrawal using pumps is commonly performed with peristaltic, submersible, or bladder pumps. Peristaltic pumps are limited to conditions where ground water need only be raised approximately 20 feet of vertical distance. Submersible or bladder pumps can be used when ground water is greater than 20 feet below the surface.

Peristaltic bladder pumps are suitable for low flow is the only pump type suitable for the collection of volatile organic samples.

Samples collected by pumping will be transferred directly from the pump discharge tubing into the sample containers during sample collection; touching the discharge tubing to the sample containers will be avoided. Samples will be collected in the following order:

- Volatile organic compounds;
- Semi-volatile organic compounds;
- Pesticides/Herbicides/PCBs/Dioxins;
- Organic indicator compounds;
- Metals (total and/or dissolved);
- Miscellaneous inorganic compounds;
- Radiometric compounds; and

- Microbial analyses.

4.3 Sample Preparation and Filtration

Specific procedures pertaining to the handling and shipment of samples shall be in accordance with SOP 150. A clean pair of gloves and decontaminated sampling tools will be used when handling the samples during collection to prevent cross contamination.

Prior to transport or shipment, ground water samples may require preparation and/or preservation. Field preparation may entail filtration, preservation in the form of chemical additives, and temperature control.

Ground water samples collected for dissolved metals analyses may be filtered prior to being placed in sample containers. Ground water filtration will be performed using a peristaltic pump and a 0.45 micron water filter. For most dissolved metal analyses, pH adjustment of the sample is also required and shall be performed after filtration or by the analytical laboratory.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements include, but are not limited to, field duplicates, rinse solution blanks, and field blanks. These samples will be collected on a frequency of one QA/QC sample per 10 field samples or a minimum of one QA/QC sample per day.

6.0 DOCUMENTATION

A number of different documents will be completed and maintained as a part of ground water sampling events. The documents will provide a summary of the sample collection procedures and conditions, shipment method, the analyses requested, and the custody history. The documents may include:

- Field book;
- Ground water sampling forms;
- Chain of custody; and
- Shipping receipts.

All documentation will be stored in the project files.

REFERENCES

Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells, EPA 600/4-89/034. National Water Well Association, 1989.

RCRA Ground Water Monitoring Technical Enforcement Guidance Document. National Water Well Association, 1986.

A Compendium of Superfund Field Operations, EPA 540/P-87/00 1. Office of Emergency and Remedial Response, Office of Waste Programs Enforcement, US EPA, 1987.

RCRA Ground Water Monitoring: Draft Technical Guidance, EPA 530-R-93-001, November 1992.

SOP 240 – GROUND WATER LEVEL MEASUREMENTS

1.0 PURPOSE AND APPLICABILITY

This SOP is concerned with the measurement of water levels in ground water monitor wells. Water-level measurements are fundamental to ground water and solute transport studies. Water-level data are used to indicate the directions of ground water flow and areas of recharge and discharge, to evaluate the effects of manmade and natural stresses on the ground water system, to define the hydraulic characteristics of aquifers, and to evaluate stream and ground water interactions. Measurements of the stabilized-water level are also needed to estimate the amount of water to be purged from a well prior to sample collection.

Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

2.0 RESPONSIBILITIES

The field project manger will have the responsibility to oversee and ensure that all procedures are performed in accordance with the sampling program specified in this SOP.

3.0 SUPPORTING MATERIALS

This section identifies the types of equipment that may be used for the measurement of ground water levels. Based on project objectives, observed or potential well contamination, and well construction, project specific equipment will be determined from the following equipment list:

- Water level or product-level measuring device;
- Distilled water dispenser bottle;
- Methanol or isopropanol dispenser bottle;
- Plastic sheeting;
- Personal protection equipment as specified in the Project Health and Safety Plan;
- Fluid level monitor records and field book; and

- Paper towels or chemical-free cloths.

4.0 METHODS AND PROCEDURES

When taking a series of fluid-level measurements at a number of monitor wells, it is generally good practice to go in order from the least to the most contaminated well. This will assist in keeping samples free of cross-contamination. All pertinent data should be entered in the ground water sampling field report (Figure 1) or the project field book. Since ground water fluctuates in elevation over time and is not static, it is very important to measure all of the stabilized ground water levels in the monitor wells at a site within 24 hours. All water level measurements at a site should be performed with the same equipment (electronic water level indicator or steel tape). Flush grade monitor wells have air tight caps that will allow air pressure or a vacuum to build up in the well if the water level in the well is above the well screen. Therefore, after the cap on a flush grade well is removed, wait approximately 5 minutes before measuring a water level to allow the water level to stabilize and equilibrate with atmospheric pressure.

4.1 Monitor Well Evaluation

Upon arrival at a monitor well, the surface seal and well protective casing should be examined for any evidence of frost heaving, cracking, or vandalism. All observations should be recorded in the fluid-level monitoring record or the project field book. The area around the well should be cleared of weeds and other materials prior to measuring the stabilized-water level. A plastic drop cloth or other material may be placed on the ground around the well if the ground is disturbed or potentially contaminated. The plastic could save time cleaning equipment if equipment should fall on the ground during preparation or operation. The well protective casing should then be unlocked and the cap removed.

4.2 Safety Considerations

If the well is suspected of being contaminated, or has a history of contamination, the stabilized water-level measurements should be made while wearing appropriate protective gear. The air in the well opening should be sampled for organic vapors using either a photoionization detector or an organic vapor analyzer. The results shall be recorded in the project field book. Detection of organic vapors in a well is the first indication of the presence of a non-aqueous phase liquid (LNAPL). If the potential for fire or explosion exists, additional monitoring shall be conducted.

4.3 Measuring Point Location

The measuring point location for the well should be clearly marked on the casing or identified in previous sample collection records. This point is usually established on the well casing itself, but may be marked on the protective steel casing in some cases. If a reference point is not marked on the well the north site of the casing will be used as a reference point for water level measurements. In either case, it is important that the marked point coincide with the point used for elevation measurement by the surveyor. If not marked from previous investigations, the water level measuring point should be marked on the north side of the well casing and noted in the fluid level monitoring record or the project field book. Monitor well measurements for total depth and water level should be consistently measured from this reference point so that these data can be used for assessing trends in the ground water flow.

4.4 Ground Water Level Measurement

Ground water level measurements shall be made using an electronic or mechanical device. Several methods for water level measurement are described below. The specific method to be used will be determined based on project objectives and site conditions.

4.4.1 Graduated Steel Tape

The graduated steel tape method is considered an accurate method for measuring the water level in non-flowing wells. Steel surveying tapes in lengths of 100, 200, 300, 500, and 1,000 feet are commonly used; a black tape is better than a chromium-plated tape. The tapes are mounted on hand-cranked reels up to 500 foot lengths; for greater depth, a motor-driven tape drive is usually

required. A slender weight is attached to the ring at the end of the tape to ensure that the tape is straight and hanging vertical and to permit some feel for obstructions.

The lower few feet of tape are chalked by pulling the tape across a piece of carpenter's chalk. Lower the graduated steel-tape from the measuring point at the top of the well until a short length of the tape is submerged. The weight and tape should be lowered into the water slowly to prevent splashing. The wet chalk mark identifies the portion of the tape that was submerged. Submergence of the weight and tape may temporarily cause the water level to rise in wells or piezometers having very small diameters. This effect can be significant if the well is in materials of very low hydraulic conductivity.

Under dry surface conditions, it may be desirable to pull the tape from the well by hand, being careful not to allow it to become kinked, and reading the water mark before rewinding the tape onto the reel. In this way, the water mark on the chalked part of the tape is rapidly brought to the surface before the wetted part of the tape dries. In cold regions, rapid withdrawal of the tape from the well is necessary before the wet part freezes and becomes difficult to read. Read the tape at the measuring point, and then read the water mark on the tape. The difference between these two readings is the depth to water below the measuring point. Errors resulting from the effects of thermal expansion of tapes and of stretch due to the suspended weight of the tape and plumb weight can become significant at high temperatures and for measured depths in excess of 1,000 feet.

The observer should make two measurements. If two measurements of stabilized water level made within a few minutes do not agree within 0.01 or 0.02 foot in observation wells having a depth to water of less than a hundred feet, continue to measure until the reason for the lack of agreement is determined or until the results are shown to be reliable. Where water is dripping into the well or covering the well casing wall, it may be impossible to get a good water mark on the chalked tape.

4.4.2 Electrical Methods

Many types of electrical instruments are available for ground water level measurements. Most operate on the principle that a circuit is completed when two electrodes are immersed in water.

Electrodes are generally contained in a weighted probe that keeps the tape taut while providing some shielding of the electrodes against false indications as the probe is being lowered into the well. Before lowering the probe in the well, the circuitry can be checked by dipping the probe in water and observing the indicator (a light, sound, and/or meter).

To obtain a water level measurement, slowly lower the decontaminated probe into the monitor well until the indicator (light, sound, and/or meter) shows water contact. At this time the precise measurement should be determined by raising and lowering the tape or cable to converge on the exact measurement. The measurement should be checked at least three times before leaving the well.

In wells having a layer of light non-aqueous phase liquids (LNAPL) floating on the water, the electronic water level indicator tape will not respond to the oil surface and, thus, the fluid level determined will be different than if measured by a steel tape. The difference depends on how much LNAPL is floating on the water. Dual media tapes are recommended in this instance to measure both LNAPL and water levels using the same measuring device.

The water level measurement should be entered in the fluid-level monitoring section on the ground water sampling field report or the project field book. The water level measurement device shall be decontaminated immediately after use following the procedures described in SOP 140.

4.5 Procedures for Immiscible Fluids

At those facilities where monitoring to determine the presence or extent of immiscible fluids is required, the sampler will need to use special procedures for the measurement of fluid levels. The procedures required will depend on whether LNAPL that form lenses floating on top of the water table or dense non-aqueous phase liquids (DNAPL) that sink through the aquifer and form lenses over lower permeability layers are present.

In the case of LNAPL, measurements of immiscible fluid and water level usually cannot be accomplished by using normal techniques. For example, a chalked steel tape will only indicate the depth to the immiscible fluid (not the depth to water) and a conventional electric water-level

probe will not respond to non-conducting immiscible fluids. Similar problems are found with other techniques.

To circumvent these problems, the use of special techniques and equipment can be specified. These techniques have been specially developed to measure fluid levels in wells containing LNAPL or DNAPL, particularly petroleum products. Another method is similar to the chalked steel tape method. The difference is the use of a special paste or gel rather than ordinary carpenters chalk. Such indicator pastes, when applied to the end of the steel tape and submerged in the well, will show the top of the oil as a wet line and the top of the water as a distinct color change. Another method, similar to the electric tape method, uses a dual purpose probe and indicator system. This probe can detect the presence of any fluid and can also detect fluids that conduct electricity. Thus, if a well is contaminated with low density, non-conducting LNAPL such as gasoline, the probe will first detect the surface of the gasoline, but it will not register electrical conduction. However, when the probe is lowered deeper to contact water, electrical conduction will be detected. The detection of a DNAPL would be similar.

4.6 Measurement of Total Well Depth

During water-level measurement, the total depth of the well may also be measured. This measurement gives an indication of possible sediment buildup within the well that may significantly reduce the screened depth. The same methods used for measuring water levels (e.g. steel tape or electrical probes) may be used to measure the total well depth. The most convenient time to measure the total well depth is immediately following measurement of the water level and prior to removing the measurement device completely from the well. The measurement device (steel tape or electrical probe) is lowered down the well until the measurement tape becomes slack indicating the weighted end of the tape or probe has reached the bottom of the well. The total depth of the well shall be recorded in the field book.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

To ensure that accurate data are collected, repeated measurements of the fluid depths should be made. The readings should be within 0.01 to 0.02 feet of each other. A secondary check, if data are available, is to compare previous readings collected under similar conditions (e.g., summer

months, wells pumping, etc.). All water level measurements should be made with the same equipment (same water level indicator) in all wells at a site.

6.0 DOCUMENTATION

Data will be recorded in the boring record, monitor well completion record, monitor well development form, ground water sampling form, or the project field book. Additional comments, observations, or details will also be noted. These documents will provide a summary of the water level measurement procedures and conditions, and will be kept the in project files.

Appendix C

Access Agreement

ACCESS AGREEMENT

This Access Agreement (the "Agreement") is made and entered into this 25 day of October, 1993, by and between the Oklahoma Department of Environmental Quality, on behalf of the State of Oklahoma (the "Department"), and Atlantic Richfield Company, a Delaware corporation ("ARCO"), with reference to the following facts:

A. The Sand Springs Home, an Oklahoma corporation (the "Home"), owns portions of that certain parcel of real property located in the City of Sand Springs, Tulsa County, Oklahoma, more particularly described on Exhibit A attached hereto and made a part hereof (the "Site").

B. The United States Environmental Protection Agency ("EPA") has designated the Site as the Sand Springs Petrochemical Complex Superfund Site. The Site is the subject of two EPA Records of Decision ("RODs"), the September, 1987 ROD for the Source Control Operable Unit ("SCOU") and the June, 1988 ROD for the Main Site Operable Unit ("MSOU").

C. EPA, the Oklahoma State Department of Health (the predecessor to the Department), and ARCO, entered into a consent decree for the SCOU (the "Consent Decree") which was entered by the United States District Court for the Northern District of Oklahoma on October 10, 1990.

D. The EPA has approved remediation of a portion of the Site by on-site solidification. This remediation will require the construction of a landfill on the Site (the "Landfill"). The Landfill will occupy that portion of the Site more particularly described on Exhibit B attached hereto and made a part hereof. The Home owns the property described in Exhibit B.

E. The Department owns an easement from the Home covering the Landfill and portions of the Site, dated October 25, 1993 (the "Easement"). The terms of the Easement permit the Department to grant a license to ARCO containing the access rights granted in this Agreement.

F. ARCO desires to obtain the access rights granted in this Agreement, and the Department agrees to provide ARCO with such access.

NOW, THEREFORE, for good and valuable consideration, the receipt and adequacy of which are hereby acknowledged, the parties hereto agree as follows:

1. Grant of Access. Subject to paragraph 2 of this Agreement, the Department hereby grants ARCO, its subsidiaries, affiliates, employees, agents, representatives, contractors, and subcontractors, and all of their successors and assigns the non-exclusive right to enter upon the portions of the Site owned by the Home and covered by the Easement, and conduct any and all activities necessary in ARCO's good faith judgment to perform the remedial actions required by the Consent Decree, including construction, operation and maintenance of the Landfill. Construction of the Landfill shall be limited to the property described in Exhibit B. The access rights granted in this paragraph shall not limit the jurisdiction or duties of the Department as provided under Oklahoma law.

2. The access rights granted in paragraph 1 above shall not exceed in any respect the rights granted from the Home to the Department by the Easement; further, the exercise of such access rights by ARCO shall at all times be limited by, and in conformity with, all duties, exceptions, limitations, conditions and requirements imposed on the Department by the Easement.

3. Use of Property by the Department. The Department shall not use or permit others to use the Site in any manner which would interfere with, damage or disturb ARCO's exercise of its rights under this Agreement. The Department reserves the right to perform sampling, inspection, and enforcement as provided under Oklahoma law.

4. Indemnification By ARCO. ARCO agrees to indemnify, defend, and hold harmless the Department for any personal injuries, including death, property damage, or other loss arising out of the activities performed by ARCO pursuant to this Agreement.

5. Miscellaneous Provisions.

5.1. Construction. The rights granted to ARCO pursuant to this Agreement are not intended to create obligations in ARCO to take or refrain from taking any of the actions permitted hereunder with respect to the Site.

5.2. Governing Law. This Agreement shall be governed by and construed in accordance with the laws of the State of Oklahoma.

5.3 Notice. All communications and notices provided for herein shall be in writing and shall be deemed to have been given either (i) when delivered in person to the recipient named below, or (ii) on the date of delivery shown on the return receipt, after deposit in the United States mail in a sealed envelope or other container, either certified or charges prepaid, addressed to the party intended as below or (iii) on the date o:

delivery by facsimile transmission to the party intended as follows:

If to ARCO:

Peter M. Grajczak
Atlantic Richfield Company
515 South Flower Street, AP-41121
Los Angeles, CA 90071
Telecopier: (213) 486-1740

If to the Department:

Dr. Dennis J. Hrebec
Project Coordinator
Oklahoma Department of
Environmental Quality
Solid Waste Management
1000 N.E. 10th Street
Oklahoma City, Oklahoma 73117-1212
Fax No. 405-271-7339

5.4. No Agency Relationship. This Agreement shall not be construed to create, either expressly or by implication, the relationship of agency or partnership between ARCO and the Department. Neither ARCO nor the Department is authorized to act on behalf of the other in any manner relating to the subject matter of this Agreement.

5.5. Severability. The provisions hereof shall be deemed to be independent and severable and the invalidity, partial invalidity or unenforceability of any one provision or portion thereof shall not affect the validity or enforceability of any other provisions hereof.

5.6. Successors and Assigns. This Agreement shall bind, and inure to the benefit of, the assigns and successors of the parties.

5.7. Entire Agreement. This Agreement embodies the entire agreement of ARCO and the Department with respect to the subject matter hereof, and no prior oral or written representation shall serve to modify or amend this Agreement. This Agreement may be modified or terminated only by a written agreement signed by ARCO or its successors and assigns and the Department or its successor agency.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the date first written above.

"DEPARTMENT" The Oklahoma Department of Environmental Quality, on behalf of the State of Oklahoma

By: Mark Coleman
Name: Mark S. Coleman
Its: Executive Director

"ARCO" Atlantic Richfield Company, a Delaware corporation

By: R Walter Simmons MBS
Name: R WALTER SIMMONS
Its: OPERATIONS MANAGER

The Sand Springs Home hereby consents to the above and foregoing Access Agreement.

"HOME" Sand Springs Home, an Oklahoma corporation

By: Joe A. Williams
Name: Joe A. Williams
Its: President

EXHIBIT A

LEGAL DESCRIPTION OF THE SITE

"Site" means the approximately 235 acres located in the City of Sand Springs, Oklahoma, in Sections 13 and 14, Township 19 North, Range 11 East, and more particularly described as: bordered on the North by Morrow Road, on the South by the Arkansas River, on the West by the Sand Springs Railway tracks, and on the East by the Sand Springs Waste Water Treatment Plant, as shown in Figure 1 of the September, 1987 Record of Decision for the Source Control Operable Unit at the Sand Springs Petrochemical Complex, a true and correct copy of which Figure 1 is attached hereto as Exhibit 1, and by this reference made a part hereof.

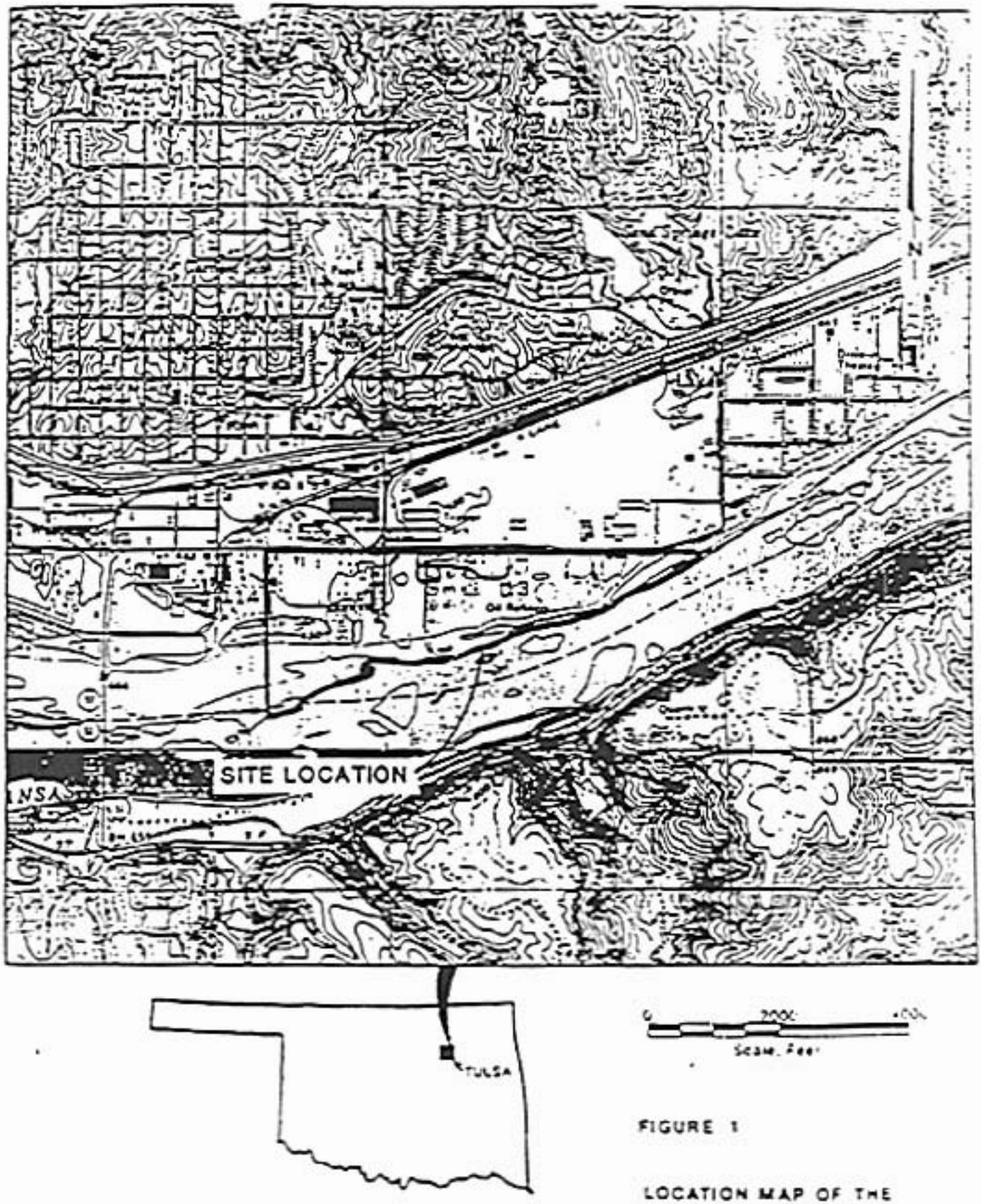


FIGURE 1

LOCATION MAP OF THE
SAND SPRINGS
PETROCHEMICAL COMPLEX

EXHIBIT 1

EXHIBIT B

LEGAL DESCRIPTION OF THE LANDFILL

A piece, parcel or tract of land located in the North Half of the Northeast quarter and fractional Lot 1 of Section 14, Township 19N, Range 11E, Tulsa County, State of Oklahoma according to the U.S. Government Survey thereof and more particularly described as follows:

Beginning at a point 616.73 feet South and 273.00 feet West of the Northeast Corner of said Section; Thence, South 88°54'13" West a distance of 661.58 feet to a point, said point being 614.28 feet South and 934.58 feet West of the Northeast Corner of said Section; Thence, South 4°47'42" East a distance of 806.70 feet; Thence, North 88°09'09" East a distance of 597.51 feet; Thence, North 0°13'40" West a distance of 797.28 feet to the point of beginning.

Appendix D

Operation and Maintenance Permits

City of
SAND SPRINGS

PO BOX 338 • 100 EAST BROADWAY STREET • SAND SPRINGS, OKLAHOMA 74063-0338 • (918) 246-2500 • FAX (918) 245-7101

Permit No. 2496

Hand Delivered to Dennis Hrebec on 12 September, 2006

Terry J. Moore. PhD
Environmental Business Mgr.
1701 Summit Avenue, Suite 2
Plano, TX 75074

RE: Issuance of IU Permit to Atlantic Richfield by the City of Sand Springs.

Permit No. 2496

Your application for issuance of a Discharge Permit has been reviewed and processed in accordance with the Code of Ordinances, City of Sand Springs, Section 17.

The enclosed issued permit (No. 2496) covers the wastewater discharged from the landfill located at 2301 South Adams Road into the Sand Springs Public Sanitary Sewer and Wastewater Treatment Plant (POTW). All discharges from this facility and actions and reports relating thereto shall be in accordance with the terms and conditions of this permit.

If you wish to appeal or challenge any effluent limitations, pretreatment requirements, or conditions imposed in this permit, a petition shall be filed within thirty (30) days of the issuance of this permit in accordance with the requirements of Sections 17-334C, City Ordinance.

City of Sand Springs Seal

By: Kevin D. West
Kevin D. West
Environmental Compliance Administrator

Issued this 9th of September, 2006.

CITY OF SAND SPRINGS
INDUSTRIAL DISCHARGE
PERMIT

PERMIT NO. 2496
ACCOUNT NO. 993802
PERMIT TYPE. NIU

In accordance with the provisions of the Code of Ordinances, City of Sand Springs, OK, Section 17-301-356,

Atlantic Richfield Co.
1710 Summit Avenue, Suite 2
Plano, TX 75074

Is hereby authorized to discharge industrial wastewater from the above-identified facility into the POTW in accordance with the effluent limitations, monitoring requirements and other conditions set forth in this permit.

THIS PERMIT IS VALID ONLY FOR THE ABOVE STATED COMPANY AT THE ABOVE STATED LOCATION. THIS PERMIT IS NONTRANSFERABLE AS TO LOCATION OR OWNERSHIP WITHOUT PRIOR NOTIFICATION TO AND APPROVAL FROM THE CITY [Ref. Section 17-334E. City Ordinance]

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit more frequently than or at a level in excess of that authorized shall constitute a violation of the permit.

This permit shall become effective upon receipt and shall **expire** at midnight on **October 31, 2011**.

The permittee shall not discharge after the date of expiration. If the permittee wishes to continue to discharge after this expiration date an application must be filed for reissuance of this permit no less than thirty (30) days prior to the permit expiration date. Ref. Section 17-334G. of the City Ordinances.

Official Seal of the City of Sand Springs

By: Kevin D. West

Kevin D. West
Environmental Compliance Administrator

Issued this 11th of September, 2006.

STANDARD CONDITIONS

THE PERMITTEE SHALL ABIDE BY THE FOLLOWING CONDITIONS AND / OR STIPULATIONS:

1. Industrial waste discharges must be within the limits as specified in the appropriate City Ordinances and/or Federal rules and regulations, or within any specific limitation herein defined.

2. Any person, firm or corporation who applies for and receives a permit under the provisions of this and applicable City Ordinances and connects to the POTW shall abide by permit conditions and applicable ordinances and accepts the jurisdiction of the City to enforce the requirements and penalties set out, whether within or without the corporate limits.

3. Provide a **sample location** and / or manhole deemed to be adequate and accessible 24 hours/day, 7 days/week if so required by the City's Designated Representative, in accordance with City Ordinance Section 17-342.

4. Procure, operate and maintain any waste **pretreatment facilities** as may be required as a condition of acceptance of the industrial wastewater into the POTW, in an efficient manner at all times and at no expense to the City, in accordance with City Ordinance Section 17-343.

5. NOTICE OF VIOLATION/REPEAT SAMPLING AND REPORTING If sampling performed by the permittee indicates a violation, the permittee must notify the Industrial Pretreatment Coordinator and/or his designee within 24 hours of becoming aware of the violation. The permittee shall also repeat the sampling and analysis and submit the results of the repeated analysis to the Pretreatment Dept. within 30 days after becoming aware of the violation. The industrial user is not required to resample if the POTW performs monitoring at the industrial user's at least once a month, or if the POTW performs sampling between the industrial user's initial sampling and when the permittee received the results of this sampling. [Reference Section 17-341(H.) of the City Ordinance]

6. REPORT OF CHANGED CONDITIONS The permittee is required to notify, in writing, the City's Industrial Pretreatment Coordinator of any **planned significant changes** to the permittee's operations or system which might alter the nature, quality or volume of its wastewater at least 30 days before the change. [Reference Section 17-341(E.), City Ordinance]

7. REPORTS OF POTENTIAL PROBLEMS The permittee **must notify** the Wastewater Treatment Plant and Industrial Pretreatment Coordinator and/or his designee **immediately** in the event of any discharge including, but not limited to, accidental discharges, discharges of a non-routine, episodic nature, a non-customary batch discharge, or a slug load which may cause potential problems for the POTW. Notification shall be made immediately by phoning the Wastewater Treatment Plant Operator on duty at the time of occurrence at 246-2599 and the Environmental Compliance Administrator, Kevin West, at 246-2603 (after 5 P.M. or on weekends call 245-1846 or page at 750-1600, then dial in your number. If unable to contact the Adminstrator outside regular working hours [8AM to 5PM], call Sharon Kercheval at 592-4438.

Within five (5) days following such discharge, the permittee shall, unless waived by the Industrial Pretreatment Coordinator, submit a detailed **written report** describing the cause(s) of the discharge and the measures to be taken by the industrial user to prevent similar future occurrences to the attention of the Industrial Pretreatment Coordinator.

A notice shall be permanently posted on the industrial user's bulletin board or other prominent place advising employees whom to call in the event of a discharge as described above. Employers shall ensure that all employees, who may cause or suffer such a discharge to occur, are advised of the emergency notification procedure. [Reference Section 17-341(6.) of the City Ordinance]

8. RIGHT OF ENTRY Persons or occupants of premises where wastewater is created or discharged shall allow the City or their representative ready access at all reasonable times to all parts of the premises for the purposes of inspection, sampling, records examination or in the performance of any of their duties. The City, State and EPA shall have the right to set up on the user's property such devices as are necessary to conduct sampling inspection, compliance monitoring and metering operations. Where a user has security measures in force which would require proper identification and clearance before entry into their premises, the user shall make necessary arrangements with their security guards so that upon presentation of suitable identification, personnel from the City, approval authority and EPA will be permitted to enter, without delay, for purposes of performing their specific responsibilities.

9. PROHIBITED DISCHARGE STANDARDS No user shall introduce or cause to be introduced into the POTW, directly or indirectly, any pollutant or wastewater, which causes pass through or interference. In addition, the permittee shall not discharge wastewater containing any of the following substances into the POTW [Reference Section 17-307]:

a. Pollutants which create a fire or explosive hazard in the municipal wastewater collection and POTW;

b. Solid or viscous substances in amounts which will cause obstruction of the flow in the POTW resulting in interference, but in no case solids greater than 1/2 inch;

c. Any wastewater having a pH less than 5.5 or more than 12.0 S.U., or otherwise causing corrosive structural damage to the POTW or equipment, or endangering City personnel;

d. Any wastewater containing pollutants, including oxygen demanding pollutants (BOD, etc.), released in a discharge at a flow rate and/or pollutant concentration which, either singly or by interaction with other pollutants, will cause interference with either the POTW, or any wastewater treatment or sludge process, or which will constitute a hazard to humans or animals;

e. Any noxious or malodorous liquids, gases, solids or other wastewater which either singly or by interaction with other wastes are sufficient to create a public nuisance or a hazard to life, or to prevent entry into the sewer for maintenance and repair;

f. Any substance which may cause the POTW's effluent or any other product of the POTW such as residues, sludges, or scums, to be unsuitable for reclamation and reuse or to interfere with the reclamation process;

g. Any wastewater which imparts color which cannot be removed in the treatment process, which consequently imparts color to the treatment plant's effluent thereby violating the POTW's NPDES permit or interferes with the operation of the POTW such as, but not limited to, dye wastes and vegetable solutions;

h. Any wastewater having a temperature higher than 65°C, 150°F, or capable of inhibiting biological activity in the POTW resulting in interference, but in no case wastewater with a temperature at the introduction into the POTW which exceeds 40°C, 104°F;

i. Any wastewater containing any radioactive wastes or isotopes except as specifically approved by the Industrial Pretreatment Coordinator in compliance with State or Federal regulation;

j. Any free or emulsified fats, waxes, greases, or oils of animal or vegetable origin in excess of 200 mg/L which may solidify or become viscous at temperatures between 32 degrees F (0 degrees C) and 150 degrees F (65 degrees C) and which, in the opinion of the Industrial Pretreatment Coordinator, it appears probable that such wastes: 1) can deposit grease or oil in the sewer system in such a manner as to obstruct the sewer; 2) are not amenable to bacterial action and will therefore pass to the receiving stream without being affected by normal sewage treatment process.

k. Any garbage that has not been properly shredded;

l. Petroleum oil, non-biodegradable cutting oil, or products of mineral oil origin, in amounts that will cause interference;

m. Any pollutants which result in the presence of toxic gases, vapors or fumes within the POTW in a quantity that may cause actual worker health and safety problems;

n. Any trucked or hauled pollutants, except at discharge points designed by the City;

o. Storm water, surface water, roof runoff, condensate, deionized water, noncontact cooling water, and unpolluted industrial wastewater, unless specifically authorized by the Industrial Pretreatment Coordinator.

p. Any sludges, screenings, or other residues from the pretreatment of industrial wastes.

q. Any medical wastes, except as specifically authorized by the Industrial Pretreatment Coordinator in a wastewater discharge permit;

r. Any wastewater causing the treatment plant's effluent to fail a toxicity test.

s. Any waste containing detergents, surface active agents, or other substances which may cause excessive foaming in the POTW;

t. Any discharge or discharge creating a condition for the POTW or the receiving waters, which violates any statute, rule, regulation or ordinance of any public agency, including EPA and ODEQ.

Wastes prohibited by this section shall not be processed or stored in such manner that they could be discharged to the POTW. All floor drains located in process or materials storage areas must discharge to the industrial user's pretreatment facility before connecting with the POTW.

No industry shall ever increase the use of process water, or in any way attempt to dilute a discharge as a partial or complete substitute for adequate treatment to achieve compliance with a discharge limitation, unless expressly authorized by an applicable pretreatment standard or requirements [Reference Section 17-339].

10. When industrial waste discharges exhibit none of the prohibited characteristics other than excessive Biochemical Oxygen Demand (BOD) and/or Total Suspended Solids (TSS), the permittee will either pretreat said discharges or pay the industrial surcharge as specified in and in accordance with the City Ordinance, Section 17-337C., or both if applicable.

11. REVOCATION OF PERMIT Wastewater discharge permits may be revoked for the following reasons:

a. Failure to notify the City of significant changes to the wastewater prior to the changed.

b. Failure to provide prior notification to the City of changed conditions pursuant to Sec. 17-341(E.).

c. Misrepresentation or failure to fully disclose all relevant facts in the permit application.

d. Falsifying self-monitoring reports.

e. Tampering with monitoring equipment.

f. Refusing to allow the City timely access to the facility premises and records.

g. Failure to meet effluent limitations.

h. Failure to pay fines.

i. Failure to pay sewer charges.

j. Failure to meet compliance schedules.

k. Failure to complete a wastewater survey or the wastewater discharge permit application.

l. Failure to provide advance notice of the transfer of a permitted facility.

m. Violations of any pretreatment standard or requirement, or any terms of the wastewater discharge permit or the ordinance.

Wastewater discharge permits shall be voidable upon nonuse, cessation of operations, or transfer of business ownership.

All wastewater discharge permits are void upon the issuance of a new wastewater discharge permit.

12. PROHIBITION OF BYPASS

a. Bypass is prohibited unless it is unavoidable to prevent loss of life, personal injury, or severe property damage or no feasible alternatives exist.

b. The permittee may allow bypass to occur which does not cause effluent limitations to be exceeded, but only if it is also for essential maintenance to assure efficient operation.

c. Notification of bypass:

1) Anticipated bypass. If the permittee knows in advance if the need for a bypass, it shall submit prior written notice, at least ten days before the date of the bypass, to the attention of the Industrial Pretreatment Coordinator.

2) Unanticipated bypass. The permittee shall immediately notify the Industrial Pretreatment Department and submit a written notice to the attention of the Industrial Pretreatment Coordinator within five days. [Reference Section 17-356C. of the City Ordinance]

13. ADMINISTRATIVE AND CIVIL PENALTIES Any user who is found to have violated an order of the City Council or who willfully or negligently fails to comply with any provision of Section 17 of the City Ordinance, and the orders, rules, regulations and permits issued thereunder, shall be fined in an amount not to exceed $1000 dollars. Additional civil penalties may be assessed. Each day on which a violation shall occur or continue shall be deemed as a separate and distinct violation. [Reference Section 17-351]

14. CRIMINAL PROSECUTION Any user that willfully or negligently a) violates any provision of the City Ordinance, any orders or wastewater discharge permits issued thereunder, or any other pretreatment requirement, b) introduces any substance into the POTW which causes personal injury or property damage, or c) knowingly makes any false statements, representations, or certifications in any application, record, report, plan or other documentation filed, or required to be maintained, pursuant to the permit, or who falsifies, tampers with or knowingly renders inaccurate any monitoring device or method required under this permit, shall be guilty of a misdemeanor, punishable by a fine of not more than $200 and/or 30 days imprisonment per violation per day. [Reference Section 17-355, City Ordinance]

15. SEVERABILITY The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provisions to other circumstances, and the remainder of this permit, shall not be affected thereby.

SPECIAL REQUIREMENTS

1. Applicable Discharge Limitations

Parameter	Limit
BOD	250 mg/L *
TSS	250 mg/L *
COD	None
pH	<5.5 or >12.0 SU
Lead (Pb)	5.0 mg/L

* These values are not limitations, however concentrations in excess of these values are surcharged (Ref. Sec. 17.339.c, City Ordinance). A surcharge appears as a miscellaneous charge on the water/sewer statement.

2. Self-Monitoring Requirements

A grab sample from each tank load of leachate will be tested for pH prior to release to the sanitary sewer.

Representative, composite samples of the leachate and the monitoring well purge water must be analyzed for BOD, TSS, COD, pH, and Lead for each collection/release event.

NOTE: All metals are total and all limits are daily average unless specifically stated otherwise.

3. Notification Requirement

Atlantic Richfield or a representative must notify, and seek approval from, this office prior to any discharge of leachate or monitoring well purge water.

4. Record Keeping Requirements

A log must be maintained in which is recorded the pH of each tank load of leachate before treatment. If the pH exceeds the established limitation, and thereby requires treatment, the pH after such treatment shall also be recorded. Also, the date and initials of the person performing the analysis shall appear next to the pH result. In addition, a record of the pH meter calibration shall be maintained. This shall include the buffers used (normally these should be 7 and 10 S.U.), the date and time of calibration, as well as the initials of the person performing the calibration. The log shall also include the date, time, and volume (in gallons) of each release to the sanitary sewer.

5. Reporting and Sampling Requirements

a. A report of all testing conducted during the previous twelve months must be submitted annually. The sampling and reporting year shall be the calendar year (January through December).

b. Sample collection:

1) A sample from each tank load of leachate must be collected for pH. A representative, composite sample of leachate must be collected during each collection event.
2) A representative, composite sample must be collect from the monitoring well purge water for each collection event.

c. All analytical results must be received by the Industrial Pretreatment Coordinator no later than the 20th of the month following the end of the sampling period. Late results may be subject to a fine as defined in Code of Ordinances Section 17-351.

d. All samples shall be handled, preserved and analyzed in accordance with 40 CFR Part 136 and amendments thereto unless the monitoring conditions of this permit specify otherwise.

e. The permittee shall be required to retain for a minimum of three (3) years any records of monitoring activities and results (whether or not such monitoring activities are required by this permit) and shall make such records available for inspection and copying by representatives of the City's Industrial Pretreatment Dept., the ODEQ or EPA.

6. Definitions:

a. **grab** – a grab sample is an individual sample collected over a period of time not exceeding 15 minutes.

Appendix E

Relevant Documents

The following project documents contain requirements, procedures, and information relevant to O&M activities:

Chronological List of Relevant Documents

Date	Title or Subject	Prepared For/ To	Prepared By/ From
May-87	Administrative Order on Consent; Proceedings under §106(a) CERCLA, 42 U.S.C. §9606(a), as Amended by SARA, P.L. 99-499.	Atlantic Richfield Company, Los Angeles CA	United States Environmental Protection Agency, Region VI
May-89	Consent Decree	Atlantic Richfield Company	USEPA & Oklahoma State Department of Health
Aug-93	Landfill Groundwater Monitoring Plan, Remedial Design/Remedial Action, Source Control Operable Unit, Sand Springs Petrochemical Complex	Atlantic Richfield Company, Inc.	Morrison Knudsen Corporation Boise ID
Sep-93	Consolidated Final Design Report, Volume XII, Post-Closure Plan, Remedial Design/Remedial Action, source Control Operable Unit, Sand Springs Petrochemical Complex	Atlantic Richfield Company, Inc.	Morrison Knudsen Corporation Boise ID
Sep-00	First Five–Year Review Report for Sand Springs Petrochemical Complex City of Sand Springs, Tulsa County, OK		Region 6 United States Environmental Protection Agency Dallas TX
May -01	Report on the Discovery of Petroleum Tars at the Sand Springs Petrochemical Complex Site, Sand Springs, Oklahoma	ARCO Environmental Remediation, L.L.C.	D&B Construction Chelsa OK
Nov-01	Annual Inspection Report for the Sand Springs Petrochemical Complex Landfill	ARCO Environmental Remediation, L.L.C.	D&B Construction Chelsa OK
Jan-02	Health and Safety Plan Sand Springs Petrochemical Complex	Atlantic Richfield Company	D&B Construction Chelsa OK
May-02	Sampling and Analytical Work Plan to Perform Test Pits Sand Springs Petrochemical Complex Sand Springs, OK.	ARCO Environmental Remediation, L.L.C.	D&B Construction Chelsa OK
Sep-02	Emergency Response Plan for Operations Maintenance and Monitoring at the Sand Springs Petrochemical Complex Site	Atlantic Richfield Company	Rightmire Consulting Services Plano TX
Sep-05	Second Five–Year Review Report for Sand Springs Petrochemical Complex City of Sand Springs, Tulsa County, OK		Region 6 United States Environmental Protection Agency Dallas TX

Sep-06	Draft Operation, Maintenance and Monitoring Plan for the Source Control Operable Unit Sand Springs Petrochemical Complex Site Sand Springs, Tulsa County OK	Atlantic Richfield Company	Stallion Environmental

Appendix F

Quality Assurance Project Plan

QUALITY ASSURANCE PROJECT PLAN

For Operation Maintenance and Monitoring

Sand Springs Petrochemical Complex

Sand Springs, Oklahoma

Prepared For:

Atlantic Richfield

Prepared By:

Stallion Environmental

Springfield, Missouri

December, 2006

TABLE OF CONTENTS

1. INTRODUCTION

The purpose of this Quality Assurance Project Plan (QAPP) is to establish procedures and criteria to be used to accomplish project data objectives. The project data objectives are designed to provide accurate, precise, comparable, representative, and complete data for Atlantic Richfield during operation, maintenance and monitoring (O&M) activities at the Sand Springs Petrochemical Complex located in Sand Springs, Oklahoma. This QAPP is an appendix to the Operation, Maintenance and Monitoring Plan for the site. Data objectives planned during O&M activities include: sample collection, laboratory analytical procedures, data validation, quality audits, and corrective action. The term "corrective action" refers to resolution of laboratory or field ambiguities. In general, the QAPP will:

- Demonstrate that the data acquisition methods and analytical methods are appropriate for achieving project objectives;
- Identify quality assurance objectives;
- Specify quality assurance and quality control (QA/QC) procedures that will be implemented to achieve these objectives;
- Describe the project organization and the personnel who will be responsible for assuring the accuracy, integrity, and completeness of the data obtained in this project.

1.1. Project Description

OM&M activities at the Sand Springs Petrochemical Complex include scheduled activities for: site inspections, maintenance, sampling of monitor wells, and collection, sampling, and disposing of leachate collection water. It may also include: soil sampling, waste material sampling and waste water sampling to determine the disposal status of the media sampled. The interpretation of laboratory analytical reports will be utilized to determine the appropriate action to deal with the disposal of media sampled.

1.2. Data Needs and Data Collection Objectives

The overall data collection objective of O&M activities is to: (a) collect information to identify maintenance needs, (1) evaluate the water quality of on-site monitor wells, (2) evaluate water samples from the leachate collection system, (3) collect soil samples to determine the characteristics of potentially excavated soil, (4) collect water samples to determine the status of collected waste water. Since data from media sampling will be collected in order to make potential waste management decisions concerning the disposal of on-site materials, the data collected must be of the type and quality to support the decisions.

Data collection objectives include:

- The samples collected are representative of the media sampled;
- The samples are collected in a manner that will not allow cross-contamination of different samples; and
- Sample handling and shipping will preserve the integrity of each sample collected.
- Sample locations are documented with sufficient detail.

2. PROJECT ORGANIZATION

2.1. Project Personnel Responsibilities

The responsibilities of the project personnel for the investigation are presented below. The Project Manager, and Site Health and Safety Officer will be provided by a contractor selected by Atlantic Richfield; the Laboratory Coordinator will be provided by an approved laboratory selected by Atlantic Richfield. Since O&M is a project of limited scope, the Project Manager may function as the Field Task Manager and the Quality Assurance Officer.

Project Manager

The Project Manager, who serves as the client's primary liaison, has responsibilities that include:

- Defining an optimum project approach of least-cost with goal oriented strategies that ensure regulatory compliance;
- Providing project information support to Atlantic Richfield;
- Providing technical review and oversight of all project activities;
- Assignment of duties to the project staff and orientation of the staff to the needs and requirements of the project;
- Supervision of the performance of project team members; and
- Budget and schedule compliance monitoring; and facilitation of good project communication.

Field Task Manager

The Field Task Manager will be responsible for field activities and data evaluation, which includes the following:

- Maintaining a record for each excavation;
- Supervising the collection of samples and providing for their proper documentation, handling, and shipping;
- Monitoring the sampling operations to verify that the sampling team members adhere to the QAPP;
- Ensuring corrective action has taken place for any items or activities that do not meet project requirements or approved work procedures;
- Coordinating activities with the Project Manager; and
- Preparing the field investigation data and information.

Quality Assurance Officer

The Quality Assurance (QA) Officer is responsible for audits and to monitor adherence to the project QA objectives. The QA Officer reports directly to the Project Manager. The QA Officer's responsibilities include:

- Validating and evaluating laboratory analytical data;
- Conducting systems audits of the project activities and reports; and
- Coordinating QA/QC operation with the Laboratory Coordinator.

Site Health and Safety Officer

The Site Health and Safety Officer will be responsible for verifying that project personnel adhere to the site safety requirements required by Atlantic Richfield and the Site Health and Safety Plan. These responsibilities include the following:

- Ensuring the appropriate health and safety training for project personnel and subcontractors;
- Supervise and implement Job Safety Analyses for definable job descriptions on site;
- Modifying health and safety equipment or procedures based on data gathered during the site work;
- Determining and posting locations and routes to medical facilities, and arranging for emergency transportation to medical facilities;
- Notifying local public emergency officers (i.e., police, fire departments, and hospital emergency rooms) of the nature of the field operations;
- Posting the telephone numbers of local public emergency services and facilities;
- Observing field project staff for symptoms of exposure or stress;
- Performing first aid if necessary on-site; and
- Performing site audits to verify adherence to the requirements of the project health and safety plan.

The Site Health and Safety Officer has the authority to stop any operation that threatens the health or safety of site personnel or surrounding populace.

Laboratory Coordinator

Responsibilities of the Laboratory Coordinator include:

- Coordinating with the project management to verify that the sampling and testing programs meet the requirements of this QAPP;
- Serving as liaison between the laboratory and other project personnel;
- Serving as the "collection point" for reporting nonconformances and changes in laboratory activities;
- Notifying the laboratory and project management of specific laboratory non-conformances and changes; and
- Releasing testing data and results.

3. QUALITY ASSURANCE OBJECTIVES

Quality assurance objectives are defined by first formulating data quality objectives and then specifying quality control parameters that can achieve those objectives.

3.1. Data Quality Objectives

The objectives of the investigation are to fill the data needs listed in Section 1.2. The data quality objectives for each of these activities are defined in terms of four categories:

1. Data objectives: the type of data required and the uses the data will be put to after it is obtained;

2. Parameters of interest: the types of chemicals or other relevant parameters required for the activity;

3. Required analytical level: the level of data quality, data precision and backup documentation of QA/QC required for chemical analysis (i.e., Category I, II, or III, discussed in Section 6.2 of the QAPP); and

4. Required detection limits: the limits of detection required to achieve the data objectives that characterize risk to potential receptors.

3.1.1. Evaluation of water, soil, waste materials and waste water samples

Data Objective: Conduct site inspections to determine that constructed areas including the landfill area are performing as designed.

Parameters of Interest: An inspection checklist that will be conducted quarterly to insure that constructed areas of the landfill are performing as designed.

Data Objective: Characterize monitor well samples and leachate collection samples to determine water quality changes over time. Analyze groundwater analytes to determine if increasing trends in groundwater contaminants exists.
Parameters of Interest: a list of sampling constitutents presented in the O&M Plan.

Data Objective: Characterize leachate collection samples to determine disposal status.
Parameters of Interest: a list of sampling constitutents required by the Sand Springs Public Owned Treatment Works.

Data Objective: Characterize soil samples and waste samples to determine disposal status
Parameters of Interest: TCLP and pH.

Required Analytical Level: Level II, a CLP package will be submitted by the laboratory for data validation and verification by EPA.

Required Detection Limits: As determined by analytical laboratory instrumentation using EPA methods 8270 for PAHs, 8260 for VOCs, 8270 for SVOCs, 6010 for metals and 9045 for pH.

3.2. Quality Control Parameters

To help achieve these data quality requirements, the following quality control parameters will be evaluated throughout the course of this project:

- Detection limits;
- Data precision;
- Data accuracy;
- Completeness of data;
- Data representative of media; and
- Comparability of data.

3.2.1. Detection Limits

Detection limits for a given parameter are determined by the analytical procedures specified in the EPA Method being utilized. An important data quality objective is to achieve analytical detection limits that will allow the comparison of analytical data to standardized health criteria for detected chemicals. The detection limits that are generated by analytical testing will be listed with the analytical sample results. A review of the detection limits that will be applied by laboratory analysis indicates that the limits associated with standard methods are sufficient to identify trends in data.

3.2.2. Data Precision and Evaluation

Data precision is an evaluation of the agreement between individual measurements of the same property, usually under prescribed similar conditions. If needed, the relative percent difference (RPD) may be calculated to define the precision between duplicate analyses in waste and soil samples.

The relative percent difference (RPD) for each component is calculated using the following equation:

$$\% \text{ RPD} = \frac{(D_1 - D_2)}{[0.5 * (D_1 + D_2,)]} \text{ X } 100$$

where:

% RPD = relative percent difference

D_1 = first sample value

D_2 = second sample value (duplicate)

Precision is determined through analysis of duplicate samples and trip blanks. Ten percent of all media samples will be performed in duplicate. Well composited samples from slightly contaminated media, if discernible, will be used for duplicate analyses. Analytical data for duplicate samples will be compared for precision. A RPD of 50% is considered an acceptable level of precision.

3.2.3. Data Accuracy and Evaluation

Data accuracy is defined as the degree of agreement between a measurement and an accepted reference or true value. To determine the accuracy of an analytical method, a sample spiking program is conducted by the laboratory. The sample spiking program utilizes two categories of spiking compounds, surrogate standards and matrix spike compounds. The results of sample spiking will be used to calculate the quality control parameter for accuracy evaluation. This parameter is referred to as the percent recovery (% R). Percent recoveries indicate the actual performance of the analytical method on real world samples. Percent recovery values will be compared to current EPA methodology quality control limits.

The percent recovery is defined as the observed concentration, minus the sample concentration, divided by the true concentration of the spike, multiplied by 100.

$$\% R = \frac{(O_i - O_s)}{T_i} \quad X \quad 100$$

where:

% R = the percent recovery

O_i = the observed spiked sample concentration

O_s = the sample concentration

T_i = the true concentration of the spike

The True Concentration is calculated from the following equation:

$$T_i = \frac{(C_{spike})(V_{spike})}{(V_{spike})(V_{sample})}$$

where:

T_i = the true concentration of the spike sample

C_{spike} = spike concentration

V_{spike} = volume of spike

V_{sample} = volume of sample

Surrogate standard determinations will be performed on all samples and blanks scheduled for organic analysis. Samples and blanks will be fortified with surrogate spiking compounds before purging or extraction.

A minimum of five percent of samples will be spiked in the laboratory with matrix spike compounds. Matrix spike compounds that fail to meet quality control criteria will be spiked into reagent water and re-analyzed. The second analysis opportunity is provided because of the statistical chance that some chemicals in a larger matrix will fail the first test. The use of reagent water in the second analysis will also reduce any uncertainties due to matrix effects. If the accuracy limits for a given chemical are exceeded twice in succession, then the laboratory performance for that parameter is considered out of bounds and the results are invalid. The problem will be identified and corrected.

Accuracy will be determined from the analysis of known laboratory spikes as discussed above. Acceptable levels of accuracy are determined by CLP protocols and are different for each parameter for each type of analytical method. Generally acceptable levels of accuracy are 50% for semi-volatiles, 30% for volatiles, and 20% for metals. All of the QC data will be reported with the sample analytical results.

3.2.4. Data Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct or normal conditions. The goal is to achieve 90 percent valid data.

3.2.5. Data Representative of Media

Analytical data must be representative of the media from which the samples are collected. Appropriate sampling procedures will be implemented so that the samples are representative of the environmental matrices from which they were obtained. Sampling procedures are described in detail in the Standard Operating Procedures (SOP) that are presented in the appendices of the O&M Plan.

3.2.6. Data Comparability

Data comparability refers to the degree to which one data set can be compared to another. Appropriate sampling and analytical processes will be implemented so that samples of similar matrices and data obtained from previous studies are comparable.

4. SAMPLE AND DOCUMENT CUSTODY

Chain-of-custody procedures are intended to document sample possession from the time of collection to disposal. Chain-of-custody procedures are detailed in SOP 150 (Appendix B) and are designed to track the history of sample custody from collection through reporting by providing adequate documentation.

After samples are collected, sample custody will be secured until delivery to a shipping company or to the laboratory. One copy of the chain-of-custody record will be kept, and the original will be placed with the samples for receipt by the laboratory. The sample cooler will be sealed with custody tape prior to delivery to the overnight shipping company. After receiving the sample, the laboratory will be responsible for sample custody. The laboratory sample custodian will sign the chain-of-custody form, and mail a copy to the sampler. If the samples are hand delivered to the laboratory, the last person to sign the chain-of-custody record will accompany the samples to the laboratory, sign the samples over to the person in the laboratory authorized to receive the samples, and keep a copy of the record. Chain-of-custody forms will be maintained with the analytical data. Copies of these forms will be submitted with the data in the final report.

5. LABORATORY ANALYTICAL PROCEDURES

5.1. General Requirements

In general, programmatic requirements for analytical procedures are established by EPA approved methodologies. The laboratory of choice will adhere to those recommendations and criteria as promulgated in 21 CFR Part 58, "Good Laboratory Practices"; "Methods for Chemical Analysis of Water and Wastes", 1979 (USEPA-600/4-79-020); SW-846 "Test Methods for Evaluating Solid Waste"; 40 CFR 136, "Guidelines Establishing Test Procedures for Analysis of Pollutants under the Clean Water Act"; and USEPA Water Supply Laboratory Performance Evaluation Program.

5.2. Laboratory Performance

Laboratories are required to adhere to federal and state performance standards and conduct periodic internal QA/QC checks. The laboratory Quality Assurance Manual or Statement of Qualifications outlines specific procedures adopted to ensure laboratory performance.

5.3. Analytical Data Review

Data validation will be performed on the data received from the analytical laboratory in accordance with EPA Functional Guidelines for Data Review to ensure that all of the contract Quality Control (QC) criteria have been met. Every component of the data package will be inspected.

6. DATA REDUCTION, VALIDATION AND REPORTING

6.1. Logging, Analysis, and Data Reduction

Upon receipt of samples for analysis the laboratory coordinator or delegate will:

- Verify all paperwork, chain-of-custody forms, and similar documentation;
- Log in samples, assign unique log numbers, and attach the numbers to the sample container(s);
- Open project file and enter data into the file;
- Assign priority and hazard rating criteria; and
- Store samples in a refrigerated sample bank.

The samples will be analyzed for requested constituents following specified EPA procedures. Data reduction procedures will follow those required by EPA methodology where formulas are specified to reduce the data. The laboratory will report values for each sample and provide results of QC sample analysis.

6.2. Data Validation

Data quality and utility depends on many factors, including sampling methods, sample preparation, analytical methods, quality control, and documentation. The EPA criteria divide physical and chemical data into categories, as follows:

Category III - Direct Support to Rulemaking, Enforcement, Regulatory, or Policy Decisions

These projects include environmental data operations that directly support rulemaking, enforcement, regulatory, or policy decisions. They also include research projects of significant national interest, such as those typically monitored by the EPA Administrator. Category I projects require the most detailed and rigorous QA and QC for legal and scientific defensibility. Category I projects are typically stand-alone; that is, the results from such projects are sufficient to make the needed decision without input from other projects.

Category II - Complementary Support to Rulemaking, Regulatory, or Policy Decisions

These projects include environmental data operations that complement other projects in support of rulemaking, regulatory, or policy decisions. Such projects are of sufficient scope and substance that their results could be combined with those from other projects of similar scope to provide the necessary information for decisions. Category II projects may also include certain high-visibility projects as defined by EPA management.

Category I - Interim Studies

These projects include environmental data operations performed as interim steps in a larger group of operations. Such projects include testing research hypotheses, estimating effects, developing methods, and other work producing results that are used to evaluate and select options for interim decisions or to perform feasibility studies or preliminary assessments of unexplored areas for possible future work.

The methods to identify and treat data outliers follow EPA methods. That is, if the analytical values do not meet the required ranges for surrogate recoveries and matrix spike recoveries, then the analysis must be repeated. If the values are within required limits, they will be reported as true values; if the values are outside required limits the data are considered to be valid but out of acceptable recoveries due to matrix effects.

6.2.1. Analytical Data

The validation of the analytical data will be performed in accordance with the accuracy and precision criteria outlined in USEPA approved methodology for analysis of chemical data. Level II will be the analytical level selected, and a CLP package will be submitted by the laboratory for data validation and verification by EPA. These procedures specify the documentation needed and the technical criteria required for validation of the data.

The laboratory will be required to submit results that are supported by sufficient backup data and QA/QC results to enable the quality of the data to be determined conclusively. Upon completion of the review, the reviewers will be responsible for preparing a discussion of the QA/QC data for the annual report. All data will be distributed, stored and maintained according to the procedures outlined in Section 13.0. Where test data have been reduced, the method of reduction will be described in the report.

6.3. Final Reporting and Archival of Documents

Upon successful completion of the data validation process, all data generated at the site will be tabulated and stored on computer disk. Data summaries and results will be submitted in final report form. This report will consist of all pertinent sample and project information; it will also make specific reference to analytical procedures.

Copies of all analytical data and/or final reports are retained in the laboratory files and, at the discretion of the laboratory coordinator, data will be stored on computer disks for a minimum of one year.

After one year or whenever the data becomes inactive, the files will be transferred to archives in accordance with Standard Laboratory Procedure. Data may be retrieved from archives upon request.

7. QUALITY CONTROL PROCEDURES

General programmatic requirements for internal quality control are established in the sampling Standard Operating Procedures (SOPs)(O&M Plan, Appendix B), the USEPA Contract Laboratory Program Statement of Works for Organic and Inorganic Analyses, Multi-Media, Multi-Concentration, and the USEPA approved methods proposed for analyses.

7.1. Field Quality Control Procedures

All field measurements and sampling will be performed as specified in the Work Plan. A performance audit will occur during sampling to verify compliance with sampling SOPS. To check the quality of data coming from the field, QA/QC data will be obtained. These samples will include blind duplicate samples and may include trip blanks.

Blind duplicate samples will be collected at a frequency of ten percent per media sample (waste, soil, and ground water). No markings or sample identification on the sample containers or chain-of-custody sheets will identify the sample as a duplicate sample.

Rinsate blanks will not be collected during sampling. This decision is based on the use of new disposable bailers and new sample collection tools for each sample collection and not decontaminated tools from a previous sampling collection.

7.2. Laboratory Quality Control Procedures

Internal quality control procedures are designed to assure the consistency and continuity of data.

If required, external QC procedures (interlaboratory checks) are carried out to assess the accuracy of the data generated. Internal QC procedures include the following:

- Instrument performance checks;
- Instrument calibration;
- Documentation on the traceability of instrument standards, samples, and data;
- Documentation on analytical methodology and QC methodology includes spiked samples, duplicate samples, and split sample use of reference blanks and check standards for method accuracy and precision; and
- documentation on procedures for sample preservation, transport, and storage times.

The laboratory used will be an environmental chemistry laboratory that strictly follows EPA approved methodologies. Therefore, to the extent possible, all analytical procedures used are those developed or adopted by the EPA. Standard laboratory turn-around times will be used for the RI.

A routine quality assurance protocol is an essential part of the analytical process. The minimum requirements for each analytical run are as follows.

7.2.1. Project Narrative

The project narrative details the analytical results and addresses any analytical problems and/or corrective actions taken.

7.2.2. Method Blank Analysis

The method blank is utilized to rule out contamination by reagent or method preparation.

7.2.3. Initial Calibration and Calibration Verification

A calibration standard is analyzed each time the instrument is calibrated. The instruments used to perform the various analyses will be calibrated and the calibrations verified as required by the respective EPA methodologies.

7.2.4. Continuing Calibration Verification

To assure calibration accuracy during an analysis run, either an EPA Quality Control Solution or a traceable control-solution is analyzed for each analyte as specified by the appropriate EPA methodology.

7.2.5. Duplicate Sample Analysis

At least one duplicate sample analysis is performed on each group of ten samples of a similar matrix. This duplicate is analyzed in addition to the blind duplicate sample that is collected in the field.

7.2.6. Matrix Spike/Matrix Spike Duplicate Analysis

The spike sample is a predetermined quantity of analyte stock solution that is added to a sample prior to extraction and analysis. The spike compound is the same, or similar to those in the environmental sample. These spikes simulate the background and interferences found in the actual samples. The results of the analysis provide information about the effect of the sample matrix on the analytical methodology. At least one spiked sample analysis is performed on each group of twenty samples of a similar matrix.

7.2.7. Interference Check Sample Analysis (Metals)

The interference check sample allows the analyst to verify inter-element and background correction factors on a regular basis.

7.2.8. Analyte Method (Organics)

Surrogate spike analyses are run on all samples.

7.2.9. Reagent Blank Analysis

The reagent blank is utilized to rule out contamination by reagents used for sample extraction.

8. PERFORMANCE AND SYSTEMS AUDITS

Planned and documented performance and systems audits may be conducted to verify compliance with specific project QA/QC program requirements for both laboratory and sampling groups. These audits will consist, as appropriate, of an evaluation of QA/QC procedures, the effectiveness of the QA/QC implementation, and evaluation of work areas and activities, and a review of project documentation.

The audits will cover both field and laboratory activities and report preparation. The audits will be conducted by QA personnel, as appropriate, under the direction of the QA Officer.

8.1. Performance Audits

8.1.1. Field Operations Audit

The field operations audit involves an on-site visit by the Project Manager. Items to be examined will, as appropriate, include the availability and implementation of approved work procedures, sampling procedures, sampling documentation, and specifications; calibration and operation of equipment; labeling, packaging, storage, and shipping of samples; performance documentation and checking; subcontractor performance; and nonconformance documentation. The field Standard Operating Procedures (SOPS) and manufacturer specifications include specific information regarding calibration of specific measuring devices, work procedures, sampling procedures, sample handling and sample shipment.

The records of field operation will be reviewed to verify that field related activities are performed in accordance with appropriate project procedures. Items reviewed will include, but will not be limited to, the calibration records of field equipment, field

activity logs, photographs, sample collection and chain-of-custody forms, waste inventories, and field log books.

8.1.2. Laboratory Operations Performance

Laboratory operations performance includes the maintenance of laboratory policies for laboratory sample control, analytical methods, procedures, and records documentation. The laboratory is responsible for ensuring that QC guidelines meet EPA standards, which will include, but will not be limited to, maintenance of documents associated with the following activities:

- Sample control;
- Calibration;
- Preventive maintenance;
- Receipt and storage of standards, chemicals, and gases;
- Data verification; and
- Records management.

Nonconformances observed during the QA/QC review of data by the QA Officer will be discussed with the Laboratory Coordinator for corrective action. The QA Officer will keep a log of nonconformances in the analytical data. If deemed necessary, the QA Officer will audit the laboratory as a corrective measure.

8.2. Systems Audit

A systems audit of project work pertaining to preparation of the report may be conducted by QA personnel under the direction of the QA Officer. The audit will examine, as appropriate, the documentation and verification of field and laboratory data and results; performance, documentation, and verification of drawings, logs, and tables; content,

consistency, and conclusions of the final report; compliance with project requirements; and maintenance and filing of project records.

The maintenance and control of project records will also be reviewed as part of the systems audit. The primary concern is that project materials, such as correspondence, memorandums, facsimiles, field and laboratory data, computer output, calculations, drawings, and reports, are properly maintained in the record filing systems. Records will be identified and maintained in a controlled manner such that the records may be retrieved throughout the course of the project.

9. PREVENTATIVE MAINTENANCE

Periodic preventative maintenance is required for equipment whose performance can affect results. Instrument manuals are kept on file for reference if equipment needs repair. Troubleshooting sections of manuals are often useful in assisting personnel in performing maintenance tasks.

Any equipment requiring routine maintenance will have a maintenance log indicating the date of required maintenance, the person maintaining the equipment, and the next maintenance date. Information pertaining to life histories of equipment maintenance will be kept in individual equipment history logs with each instrument. Appropriate and sufficient replacement parts or backup equipment will be available so sampling and monitoring are not substantially impeded or delayed.

9.1. Sampling and Analytical Equipment

Depending on the media involved and the intended purpose, a wide variety of equipment is available for sampling and analytical activities. Because of the reliance placed on such equipment to assist in evaluating the appropriate level of protection, and the use of environmental measurements to support enforcement cases, all sampling and analytical equipment whether electronic, mechanical, chemical or otherwise, will be maintained at its proper functional status.

Sampling and analytical equipment will be maintained to manufacturers specifications and in operational condition. The objective of the preventative maintenance program for sampling and analytical equipment is to avoid generating spurious environmental measurements that could endanger site personnel or lead to inappropriate remedial responses. Preventative maintenance will also help decrease the possibility of equipment

failure and delays in scheduled activities. Preventative maintenance required for laboratory analytical equipment is maintained by the laboratory according to manufacturer's specifications and good laboratory procedure.

9.2. Support Equipment

Support equipment includes items such as safety devices, storage and transportation containers, wind indicators, cameras and vehicles that may be required for completing an environmental monitoring or measurement task. Support equipment will be periodically inspected to maintain the performance standards necessary for proper and efficient execution of all tasks and responsibilities.

10.PROCEDURES FOR ASSESSING DATA ACCEPTABILITY

Media quality data generated during the sampling effort will be compiled as part of the project data and checked for validity. The following discussion describes the procedures that will be employed to evaluate the precision, accuracy and completeness of the analytical test data generated from collection and laboratory analysis of samples.

Samples collected during the field effort will be analyzed using procedures established by USEPA approved methodologies. This program provides analytical data of consistent and known quality from which a site-wide evaluation of the nature and extent of contamination can be made. Protocols and methodologies are designed by the EPA to provide data of known quality in strict accordance with quality assurance procedures and chain-of-custody and document control requirements.

The Laboratory Coordinator will review analytical results prior to external distribution.

The reviewer will:

- Compare analyses performed to the proposed testing record;
- Review results for reasonableness;
- Review quality control data results;
- Verify that required checking was properly performed; and
- Review sample preservation and holding time requirements.

If the Laboratory Coordinator finds the data meet project quality requirements, the data will be released as "final" information. Data which are not acceptable will be held until the problems are resolved or the data disallowed.

11.CORRECTIVE ACTION

Nonconforming items and activities are those that do not meet the project requirements or approved work procedures. Nonconformances may be detected and identified by any of the following groups:

Project Staff - During the performance of field investigation and testing, supervision of subcontractors, and performance of audits and verification of numerical analyses;

Laboratory Staff - During the preparation for and performance of laboratory testing, calibration of equipment, and quality control activities; and

Quality Assurance Staff - During the performance of audits.

Each nonconformance will be documented by the person identifying or originating the nonconformance. For this purpose, a variance log, testing procedure record, notice of equipment calibration failure, results of laboratory analysis control tests, post audit report, internal memorandum, or letter will be used as appropriate. Documentation will, as necessary, include:

- Name of the individual identifying or originating the nonconformance;
- Description of the nonconformance;
- Any required approval signatures;
- Method for correcting the nonconformance or description of the variance granted; and
- Schedule for completing corrective action.

Documentation will be made available to project, laboratory, and/or quality assurance management. Appropriate personnel will be notified by the management of any

significant nonconformance detected by the project, laboratory, or quality assurance staff. Implementation of corrective actions will be the responsibility of the Project Manager or the Laboratory Coordinator. In addition, the Project Manager will notify Atlantic Richfield, EPA, and ODEQ of significant nonconformances that could impact the results of the work and will indicate the corrective action taken or planned.

Any significant recurring nonconformance will be evaluated by project or laboratory personnel to determine its cause. Appropriate changes will then be instituted in project requirements and procedures to prevent future recurrence. When such an evaluation is performed, the results will be documented.

12.FILES AND DOCUMENT CONTROL

This project will require the administration of central project record files and laboratory files. The record systems will provide adequate control and retention for project-related information. Record control will include receipts from external sources, transmittal, transfer to storage, and indication of record status. Retention will include receipt at storage areas, indexing and filing, storage and maintenance, and retrieval.

12.1. Central Project Files

12.1.1. Record Control

The control of records provides for the documentation of internal and external flow of information. Following receipt of information from external sources, completion of the field and laboratory phases of the project, completion of analyses, and issuance of reports or other transmittals; associated records will be submitted to the central project files. Records will be legible and easily identifiable. In addition, field records and records transmitted between field sampling personnel and the analytical laboratory will be adequately protected from damage and loss during transfer. Computer disks must be transmitted with special care to avoid magnetic fields, bending, extreme temperatures, or other damage.

Field records, laboratory data summaries, test data, numerical calculations, reports and other data transmittals, copies of purchase orders for project services, and contracts, correspondence including incoming and outgoing letters, memorandums, and telephone records, photographs, reference material, and drawings will be transferred to the project central file. Floppy disks containing computer data and information will be submitted to the computer area for storage.

Records submitted to the project central file will be placed in folders or otherwise secured for filing.

12.1.2. Record Status

Project personnel will be responsible for reporting obsolete or superseded project-related information to the Project Coordinator. In turn, the Project Coordinator will notify the appropriate staff personnel of the resulting status change in project documents.

To denote calculations, drawings, and other material that have not been formally checked, or which are based on information that has not been checked or reviewed, will be marked "DRAFT".

12.1.3. Record Retention

Record storage in the central files will utilize facilities that provide a suitable environment to minimize deterioration or damage, and that prevent loss. The facilities will have controlled access and provide protection from excess moisture and temperature extremes. Records will be secured in folders, envelopes, or other secure storage containers (e.g. file cabinets). Storage systems will provide for the prompt retrieval of information for reference or use outside the storage area.

12.2. Laboratory Files

The laboratory will maintain a records management system for documents pertinent to analytical performance. This system will provide record control for analytical performance similar to that discussed for the central project files.

The major difference between the laboratory and central file systems is the types of records maintained. Laboratory records will be maintained in two broad categories:

- Documents that are specific to the project, such as chain-of custody, raw analytical data, and analytical reports; and

- Documents that demonstrate overall laboratory operation, such as instrument log books and control charts. These records will directly affect the data for a specific project, but in general their applicability is not limited to one project.

Laboratory data summaries will be submitted to the Project Coordinator and central project files in both hardcopy (printed) form and as spreadsheet data on computer disks. A copy of the printed analytical data report and spreadsheet data on computer disk must be maintained in the laboratory files.